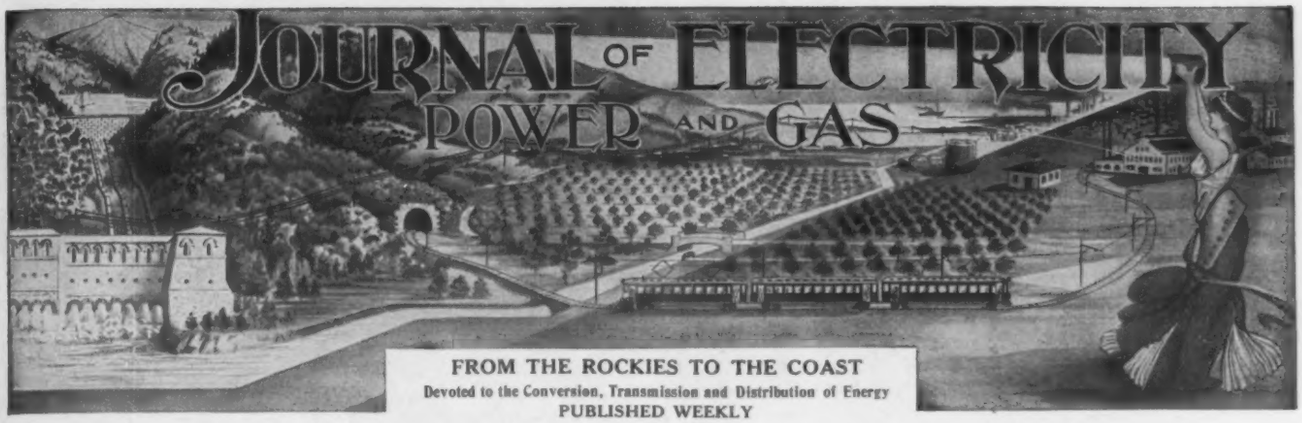
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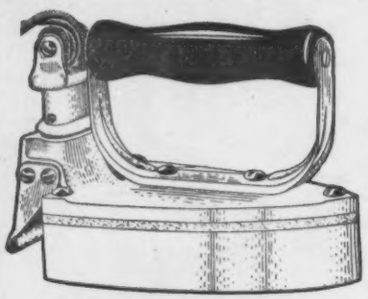

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VOLUME XXI. SAN FRANCISCO, CAL., OCTOBER 17, 1908 No. 16

HIGH VOLTAGE INSULATORS.*

By H. R. NOACK

In the early days of power transmission practice, glass insulators were more largely used than those of any other material. This was no doubt due to the fact that suitable types and sizes were more readily obtained in glass. No commercial nor perfection in manufacture. Hence it was that a great deal of trouble developed in the early porcelain insulators, whereas at the voltages used upon power transmission lines, glass insulators gave fairly efficient service.

Commercial Testing of High-Tension Insulators.

factories for the exclusive manufacture of porcelain insulators had been established, and the few porcelain insulators which were manufactured were made in potteries devoted more to the manufacture of low voltage porcelain ware such as knobs, tubes, cleats, etc., and not calling for the highest grade of porcelain

At the period referred to (some twelve to fourteen years ago), the general commercial voltages were in the neighborhood of 20,000 volts, although there were some few instances of higher voltages in successful operation. At that time, glass insulators of the triple petticoat type from five and one-half to six inches in diameter were successfully used at 20,000 volts. This type was succeeded by glass insulators seven inches in diameter, which proved fairly serviceable at as high as 40,000

*Paper read at meeting San Francisco Section of the American Institute of Electrical Engineers, Sept. 25, 1908. Much of the data in this paper is taken from an article on "High Voltage Insulator Manufacture" by W. T. Goddard.

volts under suitable conditions. With one or two exceptions, the seven-inch diameter glass insulator has been the largest commercially manufactured and used. In the early development of the art, it was claimed that glass insulators possessed numerous advantages over porcelain. One of the principal advantages mentioned was that of being able to determine the existence of flaws or imperfections by visual inspection. High voltage testing apparatus had not been sufficiently introduced to make the universal testing of insulators practicable, and as it was considered that a porcelain insulator must be tested before use, their general use was discouraged.

As transmission lines began to increase in length and the demand for high voltages increased, it became necessary to enlarge the size of the insulators. It was soon found that there were decided limits to the size to which glass insulators could be extended; the reasons being inherent in the very nature of the glass itself, and its process of manufacture; that is, increasing the size of glass insulators necessitated the manufacture of masses of glass which could not be readily annealed, and even though annealed according to the best practice of the glass factories, extreme changes in temperature after erection on the poles set up strains within the glass due to expansion and contraction which often resulted in failures. This not only applies to the larger types of glass insulators but has been a frequent cause of trouble upon small glass insulators subjected to a wide variation in temperature.

Although the general practice has practically driven glass insulators from the field upon any new high voltage transmission work, yet the glass insulator still has its place and can be used successfully at moderate voltages; that is, up to 25,000 to 30,000 volts, under suitable climatic conditions, with success almost equal to porcelain. At the present time the only valid reason for using glass insulators in place of porcelain, seems to be the question of initial cost. Generally speaking, the average price of glass insulators should not be over fifty per cent of that of porcelain of the same general type.

Turning now to the question of porcelain insulators, it would appear that an engineer to properly design a high tension insulator should first be conversant in a general way with the process of manufacture in order to know the limits of shape, size, thickness, and other problems of manufacture which of necessity influence the design of the commercial insulator. Therefore, a short description of the process of manufacture will probably not be out of order.

Porcelain for electrical purposes is a mixture of ground flint or silicon dioxide, and feldspar or potassium aluminum silicate, raised to a vitrifying temperature; that is, to a temperature sufficiently high to melt the feldspar, and from it unite the parts of flint into a perfect homogeneous body of uniform electrical and mechanical strength. The production of electrical porcelain differs from the ordinary pottery product in that in addition to presenting a symmetrical and flawless exterior it must possess inherent electrical and mechanical strength.

Though very finely ground and apparently in the last stage of subdivision, the clays after having been properly mixed as to quantity of each, are placed, together with sufficient water to form a liquid mass, in a ball mill or large iron tub lined with porcelain brick and half filled with quartz pebbles selected from the glacial drifts of Iceland. The tub is caused to rotate on its supporting axle and the quartz pebbles still further reduce the clays in matter of fineness and thoroughness of mixture. From the ball mill, the mixture of clay and water is run through a lawn or 150-mesh screen to a cistern from which it is drawn by means of a power pump and forced into filter presses. Filter presses for this class of work are of the type used in many potteries, and consist of a series of cast iron rings separated by sheets of canvas pierced by a three-inch hole to admit the liquid clay. The canvas sheets so arranged form a series of pockets from which water may readily leak, but in which the clay is retained—thus forming "leaves" about thirty inches in diameter. As the pockets become filled with clay, the pressure steadily rises until no more can, with safety, be applied. The clay is then ready for working, but to ensure its being homogeneous and thoroughly pliable it is put through a pug mill or large sausage machine, which forces it through a die under pressure from whence it emerges as a long "sausage" about four inches in diameter. In this state it is delivered to the potter, who is thus furnished with a perfectly pliable and reliable clay upon which to work.

The process of drying and firing of electrical porcelain causes it to shrink about fifteen per cent, and accordingly the model of the insulator from which all moulds are made is fifteen per cent larger than the finished piece of ware. Such models are usually turned from blocks of plaster of paris, their surfaces oiled, and the moulds cast from them in one, two or three parts as occasion may require.

Having been properly dried, the moulds are filled with just enough clay by the potter's assistant, and are placed by the potter upon his wheel where the operation of shaping the inner side of the particular piece under consideration is carried on by the aid of the hands and a properly shaped former, which is held in place mechanically, and thus produces a perfectly uniform shape inside. The outside of course is determined by the shape of the mould. The mould with its clay is now set aside for some hours, during which time the plaster performs its functions of absorbing the water of the clay immediately adjacent to it. The clay has now become dry enough to handle, and is removed from the mould and carried to the finisher, who, by means of a revolving table, sets the partially dry ware to rotating, a wet sponge, and if necessary, a sharp knife being used to remove any irregularities and produce a smooth exterior. The piece thus finished is now set away and allowed to dry completely, after which it is dipped in a silicate solution, some of which is absorbed in the ware, thus forming a thin glaze or glasslike surface, whose only function is to produce a smooth finish as well as impart color to the insulator. At present a dark brown color is usually employed because of its supposed inconspicuousness compared to white; however, it is possible to produce any desired color by placing in the glaze the proper coloring matter.

In some of the smaller sized insulators the glaze accomplishes a double purpose, for besides covering the surface of the ware, it is made to serve as a cement for fastening the parts together, forming a neat and strong joint, for the glaze liquefies at the temperature at which the body vitrifies.

The kilns in which the ware thus prepared is fired are cylindrical, being about eighteen feet in diameter and sixteen feet high, lined with firebrick, and arranged with fire bags around the base, the fire from which is drawn over into the kiln and down through the floor and thence to the chimney. In order to protect the insulators during firing, they are placed in fire-clay receptacles called "saggers," which are piled one on the other until the inside of the kiln is completely filled, after which the entrance to the kiln is bricked up and sealed with fire-clay mortar. There remains now but to gradually raise the temperature to the required degree, which point is made evident by the fusing of small porcelain cones placed at regular intervals about the kiln, an opening being left so that ready access may be had to them. Before each opening are placed four cones which fuse at various heats, and in firing a kiln, the temperature is raised until three of each set of cones are fused and the fourth very nearly so. In watching the cones the heat is so intense that a man cannot face it unprotected, and the light is so dazzling that a colored hand-glass is necessary to soften it so that the eyes can endure it. The heat is raised with such regularity that no unnecessary strains are created in the ware by sudden variations in temperature. The heat within some parts of the kiln is so intense as to fuse the firebrick with which the sides are lined. The proper heat having been attained, the fires are allowed to cool down and the annealing process carried on until an insulator absolutely free from internal strains is assured. The door is broken down and the finished insulators pass from the ceramic to the electrical test and shipping departments.

It has been found that the economical limit of size in a single piece of porcelain is about fifteen to sixteen inches in diameter, although larger pieces have been manufactured; notably the 75,000-volt insulators of the Kern line of the Edison Electric Company, which have a top diameter of eighteen inches.

The nature of the process of manufacture puts a decided limit upon the shape and size of the various parts of a porcelain insulator, and owing to the difficulties in burning, to say nothing of the expense entailed, all pieces of a large diameter, and at the same time of any considerable height, should be avoided. It is also well known that owing to the difficulties encountered in burning, all sharp angles should be avoided, and further, that each piece of ware should have a uniform thickness in all its parts, for the reason that if there is any considerable variation, the evaporation will be more rapid in the thin portions and cracks will be developed in drying, which will be aggravated in the burning.

It was formerly believed that the glaze upon the exterior of the porcelain insulator possessed greater insulating qualities than the body of the insulator. This idea no doubt became prevalent, due to the fact that the early porcelain insulators were made of inferior material, and oftentimes the porcelain was more or less porous. The glaze performed the function of filling up the pores and forming a glass-like surface of high dielectric strength, at the same time keeping the porcelain from absorbing moisture and becoming clogged with small particles of foreign matter which would eventually serve as a pathway for current leakage.

At the present time, the porcelain body of high tension insulators does not depend upon the glaze as an insulating medium as the porcelain itself, while clean, will stand the same test potential as with the glaze. The glaze, however, performs the important function of smoothing over the natural imperfections of the body of the porcelain and preventing the collection of foreign matter which would serve as a leakage path.

Glazes are of two types, namely, soft and hard. The soft glaze is merely a soft lead glass with sufficient clay present to prevent its settling until placed on the ware. Such a glaze is naturally very unreliable, not only because of the tendency of lead to volatilize under heat, but owing to its glassy nature, it is not able to expand and contract equally with the body of the ware, and the result is crazing. By "crazing" is meant that cracked condition of the glaze so commonly noted in art and table ware, and caused by sudden variations in temperature, making the mass expand or contract. Soft glazes being a species of glass, their power of expansion is not equal to that of the body to which they are attached; hence when a change in temperature occurs, the strain becomes too great for the brittle glaze, and breaks occur, leaving the glaze in small individual pieces on the surface of the ware. Crazing may not appear for some considerable time after the insulator is placed in service, but the elements will eventually cause this to occur.

Hard glaze—which is the type used upon all high grade porcelain insulators—is the true porcelain glaze, and its essential features are:

First. **That it shall be composed of practically non-volatile substances (which excludes lead).**

Second. **That it shall contain only enough flux to fuse the matrix of silica and clay, and shall not flow or run.**

Third. **That the body shall be sufficiently absorbent when the glaze is applied so that the glaze may attack it and thus make a perfect union under the fire action.**

Fourth. **That the body and glaze shall have the same co**efficient of expansion and shall mature at the same temperature.

It is much more difficult to produce a smooth and uniform surface where lead is not used, which may account for the wide difference in beauty of finish of insulators of different makes.

Any desired coloring can be obtained by the use of the proper colorants. The most generally accepted color at the present time is brown, although slate, or a neutral tint, has been extensively used. It is claimed that either brown or slate is much more inconspicuous upon the pole line than white, but no glaze which has yet been observed by the present writer has been found sufficiently inconspicuous to make its selection of any particular advantage in preventing damage to insulators by miscreants.

The matter of glazing joints does not usually come up for discussion in the consideration of insulators of the higher voltages, that is, 60,000 and over, but there is yet some considerable difference of opinion regarding glazed joints versus cemented joints for the moderate voltages, say from 25,000 to 35,000 volts. An insulator made with glazed joints, after having successfully passed the various mechanical and electrical tests, and having been placed upon the line in good condition, is undoubtedly as good an insulator as one made with cemented joints. When it is understood, however, that an insulator with glazed joints must be fired as one piece in the kiln, it will readily be seen that in the failure of any one piece, the entire insulator becomes worthless. This necessitates adding the loss of a higher percentage of parts to the factory cost, which the consumer is expected to pay. It will also be noted that unless a hard glaze is used in glazing the joints together, a loosening of the joints is liable to occur in the course of time, due to variation in temperature, for reasons above explained, namely, the different co-efficient of expansion of the porcelain and the glaze.

The method of testing high voltage insulators is so well known that a description will not be attempted here. Owing to the nature of the ware it is generally conceded that all high voltage porcelain must be tested by wet test according to one of the usual methods in order to determine if any flaws which are not perceptible to the eye exist. Many of the imperfections in the body of the porcelain ware are microscopic and others are entirely concealed by the glaze so that the electrical test is absolutely essential.

In general, the electrical test applied to the various parts of multi-part insulators is kept very near to the arcing over point, but there are limits to this test as described later. The number of failures under test is usually from two per cent to three per cent of the number tested. Once punctured, the porcelain is ruined and can by no known means be recovered.

The parts of multi-part insulators are united by means of pure Portland cement mixed with water only. After the cement has obtained the initial set, the insulators are subjected to an assembled electrical test of double line potential for a period of time sufficient to remove all doubt as to the electrical strength of the insulators, usually from one to five minutes.

Design of High Voltage Insulators.

Insulators for the lower voltages call merely for the introduction of sufficient good material between line and supporting structure to prevent destructive leakage. For voltages up to 20,000 little or no difficulty is experienced in securing such insulation, but above that voltage it becomes not only necessary to have good material in plenty, but it must be properly distributed in order that danger of puncture and severe leakage be reduced to a minimum.

The manufacture of good porcelain from a mechanical standpoint forbids that it be made so vitreous as to resist a puncture test of 65,000 to 70,000 volts through ½-inch or ⅝-inch thickness. It is useless to attempt to gain greater dielectric strength by increased thickness since individual cracks in thick pieces really reduces the effective strength to that of ½-inch or ⅝-inch porcelain. Accordingly it has come to be recognized as best practice to make no attempt to manufacture high voltage insulators in a single piece, but rather to secure greater electrical strength by multiplicity of parts. Though entirely possible to construct 30,000 volt insulators of one piece, and still apply a double potential test, experience has demonstrated that a multi-part insulator is much less liable to fail entirely when struck by stones or bullets than large single-piece insulators, and so prevents complete shut down of the transmission line. There

are many instances on record in which transmission lines have operated at long periods with the various petticoats of some of the insulators broken entirely away, leaving only enough of the insulator for mechanical support to the wire.

For the reason that greater safety from breakage, either mischievous or otherwise, is gained, as well as for greater normal safety factor, engineers are selecting multipart insulators at higher cost even for the lower voltages. In general, two-piece insulators are used for from 10,000 to 30,000 volts; three-piece for from 30,000 to 50,000 volts and four-piece for 50,000 to 75,000 volt lines now in operation.

Above 75,000 volts, the under-hung or suspension insulator works out more economically, and for entirely different reasons five to ten shells of porcelain are introduced.

Considerations of puncture strengths are the first concern of the designer. As before noted, good electrical and mechanical porcelain should be made of not more than ⅝-inch thickness with an ultimate electrical strength of not more than 70,000 volts. To give greater electrical strength, it is necessary to introduce other shells which continue to add a proportional dielectric strength up to about 220,000 volts, at which point the curve gradually tends to become flat, and becomes very nearly so at 300,000 volts. With this to start with it is a very simple matter to provide insulators for any voltage up to the point where difficulties of manufacture begin to interfere with progress.

The 10,000 and 20,000 volt insulators have little to do with puncture strength, provided of course that the porcelain is of good quality, and so the question reduces to the form of necessary leakage distance and carrying capacity when subjected to an artificial rain approximating the worst conditions to which the insulator will be subjected. This is not so simple as appears on the surface, for while an insulator may behave admirably under a downpour of unprecedented intensity, Nature cannot be expected to limit herself to a vertical, or what is technically known as a 45 deg. rain, and moreover the precipitation is very likely to continue for a considerable time and be accompanied with sufficient wind to blow the rain very nearly horizontally.

It can be expected that after the first half hour of precipitation the inside of the innermost shell will have become thoroughly wet and the surface leakage comes into play. As is well known the persistence of any arc of definite length has to do with the voltage impressed and the current flowing and the failure of an insulator is of course amenable to the laws which govern arcs. A designer should assume that his insulator will sometimes become wet all over and should provide sufficient leakage resistance to prevent any considerable amount of current flowing, a small amount merely tending to dry off the insulator, whereas a large amount would most likely start a disastrous arc under the shells and would completely destroy them by its heat before extinguishing itself. Such an insulator represents very nearly the ideal, and it is to be regretted that so few lines are equipped with insulators of so great a margin of safety. It is usually true that only once or twice a year are insulators called upon to perform extreme duty. In fact, the insulators of most lines are for the greater part of the time working very inefficiently, probably at not over 20 per cent of their rated capacity.

The next best thing is to provide as much dry surface as possible under average storm conditions, and to this end it is of value to note the progressive wetting of an insulator under rain. It is customary to mount the insulator well above the cross-arm, so that all of its shells are far removed from water spattering up from the arm. Assume an insulator of conventional design of three or four shells; the top becomes dripping wet at once, and the film of water held on the surface carries line potential to the outer edge. A certain amount of rain gets by the top and strikes upon the lower shells; part spattering upward and part downward, depending upon the angularity of precipation. That portion which spatters upward soon wets the entire under surface of the shells above, and in this manner the potential is carried down to the lowest projecting shell. At this point the leakage path is broken, due to the fact that beneath the lowest shell there is no surface from which spattering may occur, and consequently it remains, and under this condition the central shell of the insulator is carrying the total strain, both as to puncture strain and against flash-over.

It therefore frequently happens that there is but one effective shell of porcelain interposed between the current which is leaking over the various portions of the insulator and the supporting pin. It has been pointed out that one thickness of porcelain should not be called upon to stand a puncture test of more than 60,000 volts. It will therefore appear that there may be cases in actual practice where the innermost shell of an insulator may be called upon to withstand this extreme voltage; hence the necessity for a well-designed and well-protected innermost shell, or center, as it is commercially called. The various shells must of course remain wet until the storm is over or some drying action is introduced. If the gap between the edge of the lowest shell and the pin is small enough, a small arc will be established, thus completing the circuit and permitting a leakage current, formerly held in check by the dry inner surface of the shell, to flow, though limited in volume by the relatively high resistance of the pure water film covering the insulator. This leakage current heats and vaporizes the water film; its first action naturally being where the current density is greatest at the neck of each shell, where fortunately the surface is not subjected to the direct force of the rain. Since potential is in no way concerned with resistance, the thinnest and consequently highest resistance film of water is sufficient to inaugurate the drying process, so that an insulator in service, if properly designed, will readily take care of itself.

From the foregoing, it will be seen that the dielectric strength of the inner shell of any multipart insulator and the distance between its lowest edge and the supporting pin are of utmost importance; the remainder of the insulator serving as a little more than a resistance in series, or leakage distance, to limit the amount of current which may flow when arcing takes place. What has been said applies to insulators as it is necessary to *build* them to meet mechanical conditions imposed, and it is the mechanical characteristics—not the electrical—which influence their cost. Were it possible to make a porcelain wire of great strength, an insulator of perfect certainty of action could be produced at minimum cost. An insulator should not be regarded as an absolute barrier to current, but rather as a high resistance path between line and earth, and its design should aim to serve this purpose.

There has been considerable discussion with regard to the proper shape of the outer shells composing a multipart insulator; some engineers advocating concave; others, convex; and others, straight shells. There seem to be excellent reasons in support of all three shapes and an adjustment between the desirable points of the three calls for fine discrimination. The shape of the outer shells has a direct influence upon the amount of spattering of rain-water upon the under surfaces of the remaining petticoats. The convex shell will probably keep dry the longest, since a large portion of the falling water is degained between the various shells by the use of the concave flected away. On the other hand, much greater clearance is shape.

The foregoing applies equally well to low-voltage insulators, though up to 40,000 volts it is hardly necessary to provide protection for the innermost exposed shell, since its own strength is entirely ample.

So much space has been given to the discussion of the value of the insulator when under rain that its pleasant-weather qualities may seem to have been overlooked, but there are sudden and severe demands upon an insulator in pleasant weather, mainly from lightning and switching. When a rise of

potential far above normal working voltage comes upon a perfectly dry insulator, the stress between line wire and pin is very sensibly increased, and that this stress shall not be too severe, the distance between line wire and pin should be made ample by the introduction of several shells of porcelain. The specific inductive capacity of porcelain, or its flux-carrying capacity, is a perfectly definite thing, compared to air about 4.4, so that for any given potential, area of contact, and thickness of shell, the density is determined. Porcelain, however, unlike some dielectrics, gives due notice, when overburdened, by a pale violet light over its entire surface.

Mechanically insulators can be designed for any load by the proper disposition of material. Good electrical porcelain has a crushing strength in excess of 15,000 pounds and tensile strength ranging between 1,500 and 2,000 pounds per square inch.

One of the worst conditions which Pacific Coast engineers have been called upon to contend with is the heavy sea fogs, immediately adjacent to the coast. These fogs are particularly troublesome when they occur during the summer months, or before the rains have had an opportunity to clean the summer's accumulation of dust and other foreign matter from the surfaces of the insulator. Under fog conditions, as stated above, it has been found necessary to greatly increase the creeping distance from line wire to pin. As stated in the early part of this paper, there are decided limits to the commercial size of a piece of electrical porcelain. Added creeping distance has been very ingeniously introduced, without increasing the outside dimensions, by means of corrugations. To be of the greatest service, these corrugations should be wide and deep, to prevent insects and foreign matter from filling them up and reducing the surface to the same (or lesser) value as a plain surface.

The latest development in exceedingly high-voltage insulators is a reversion to a type long since discarded by lower-voltage engineers; that is, the underhung or suspended type of insulators. The first English telegraph systems were insulated by underhung insulators of bowl-shaped porcelain, and, to come down to the present time, our trolley wires are suspended below a supporting device.

The reason for using suspended insulators is largely a matter of cost, since it is entirely possible to build porcelain insulators of the conventional type of sufficient size to successfully operate at any voltage, but the extreme height and diameter of a pin-type insulator for 100,000 or 150,000 volts make the cost prohibitive. A suspended type of insulator has several advantages which it is well to understand before going into details of design. Of paramount importance is the unit formation, making it possible to increase the effective insulation whenever it is desired to raise the line voltage or wherever it seems desirable to present extra leakage surface because of salt fogs, smoke from railways and factories, or other adverse conditions. Many lines start operation at much lower potential than designed for, because the initial load is light and the potential need be increased only when regulation demands it. With the pin type of insulator there is no alternative but to invest at the start in the largest insulators which the line will ever need, whereas, in the suspended form, additional units may be introduced whenever the growth of power business warrants an increase in potential. In the pin type of insulator the nearness of line wire and pin must always prove a weak point for lightning assault as well as an aggravator of line-charging current difficulties. The suspended type gets away from both difficulties by a wide separation of line conductor and supporting structure. Incidentally the position of the conductor below the cross-arm permits the supporting structure to act as a lightning rod, and so to relieve the line of much lightning stress.

Mechanically, provision must be made to prevent the swinging conductor from coming too near the tower structure, but the extra length of cross-arm necessitated by this feature is more than compensated for in cost by the fact that there are no twisting strains upon the arm.

Insulator unit formation presents another very positive advantage in the matter of breakage. When a shell of a pin-type insulator becomes cracked or broken, the whole device is rendered worthless, as it is utterly impossible to break the cement joint forming the bond between shells. Further, the cracking of a shell, especially an inner shell, may cause immediate shut-down or at least shut-down during the first severe rain storm. On the contrary, the breaking or cracking of one of the shells of a suspended unit-type insulator takes away but that one unit from the series; thus, in the case of a 5-unit, 100,000-volt insulator, a broken unit reduces the total strength but 20 per cent.

Insulators in Five Minute Rain Just Previous to Failure at 200,000 Volts.

With these very evident advantages, it is small wonder that, with voltages reaching toward 100,000, the underhung insulator should be adopted. The first question, that of mechanical strength, was promptly disposed of by so designing porcelain parts that strains were all compression. The next question, that of electrical strength under normal operating conditions, was not so easily solved. In the first designs, single shells of porcelain of $\frac{5}{8}$-inch thickness were used, but when a series of 5 such shells was subjected to a 300,000-volt test, a new condition was found to have been introduced in the way of a potential rise around the first units, and it was found by repeated test that any sudden application of potential, or even change in potential already applied, would puncture the end shells, which, if made of economical pottery size, i. e., 14

inches diameter, would have a flash-over potential of approximately the ultimate puncture strength. This condition analyzes somewhat as follows: The shells and metallic connecting links form a condenser of certain definite capacity, which for the sake of analogy may be likened to a mass of rubber or other elastic material. Carrying out the analogy, the rubber is struck a smart blow with a hammer. The surface struck and layers of material immediately adjacent to it, feel the force of the blow most severely, and if the mass be thick and of great inertia, the force of the blow is barely perceptible on the surface opposite to that where the blow was struck. Moreover, the elastic material is no sooner struck and compressed than it attempts to return to its normal shape. This property of inertia is duplicated in the action of condensers in series; call it what you wish, dielectric hysteresis, or anything else, the effect is there, and if proper precautions are not taken, the outer layer of resisting medium, in this case a porcelain shell, will be disrupted. Unquestionably the dielectric strength of the unit must be increased, and the proper method is by supplying an inner protecting shell, so that the puncture strength of the built-up unit shall be far in excess of its flash-over potential. A unit so constructed is practically indestructible, and will carry continuously its flash-over potential without heating or its surface being covered with static, which impairs the efficiency by shortening the leakage path. Under normal operating conditions the end unit is the only one which is subject to unusual strains, but the failure, either by mechanical breakage or arcing over, may at any time put similar strain upon other units, so it is a wise provision to guard all shells against possible puncture. Having made the unit secure against puncture, the next concern is with leakage distance, which must be made of sufficient length to prevent any considerable current flow when the entire surface is covered with a thin film of water. Here again cost governs, since the unit construction permits the use of a few large or several small parts. As noted before, 14 inches is an economical size for the potter to produce, and, as the metal parts are the same for any diameter of shell, it is this size which returns most in insulation for each dollar invested. The shape of the shells is not of importance, since in testing to flash-over under working conditions pains were taken to wet all surfaces thoroughly and so produce artificially the worst possible conditions; but it must not be taken for granted that leakage over an insulator is a desirable thing; in fact, the time when an insulator will leak sufficiently to dry itself should be postponed as long as possible by logical designing. To accomplish this it is of course necessary to permit as little water as possible to spatter on the under side of the shells, and this is best effected by deflecting the water away rather than toward the insulator. If this were the only thing to consider, the best shape of shell would still be in question. There are, however, other conditions. When, in the course of a severe storm, the under as well as the upper shell surfaces have become thoroughly wet and leakage has commenced, the first spot to become dry is the inside of the innermost shell at the point of smallest cross-section, and a small arc is at once formed, which, if allowed to persist, will heat and crack the shell. To avoid this, the edge of the shell is brought down till the lower edge of the outer petticoat is of such a distance as to induce the arc to play between it and the malleable iron cap of the unit immediately below.

An arc of considerable magnitude may be maintained between these two points without heating the shells above sufficiently to cause cracking, since the air currents established tend to keep down the temperature. Current sufficient to support such an arc will, unless the rain be very heavy indeed, dry a portion of the upper surface of the shell, which causes the arc to straighten out, and if there be sufficient current at high voltage, it will eventually be held between the conductor and the supporting structure. There is thus a progressive breaking down between the beginning of actual leakage and the maximum arc, which is not sufficiently close to the insulator to damage it. With only 500 kilowatts at 300,000 volts available, the above deductions were found to be true and the ability of the design to rid itself of arcs formed upon it demonstrated beyond question. The suspended insulator thus becomes an automatic relief valve, which may be relied upon to discharge the line safely and effectively without damage to itself or serious interruptions to the service.

The underhung system of insulation works out with pleasing directness and simplicity, and its comparative cheapness argues for its wide adoption for the higher voltages. The cost of such insulators, as at present manufactured, ranges from $1.60 to $2.00 per unit, depending on the nature of the fittings. At least two 14-inch units would be required for 60,000 volts, and as a good 60,000-volt insulator can be secured for prices ranging between $1.70 and $2.30 each, the question of the use of suspended units for voltages below 75,000 to 80,000 is largely one of safety factor and investment.

The foregoing has given little which could be used in the determination of the proper insulator to use for any particular voltage, and it is quite in point to add here that every case is special. Insulators well suited to one locality are out of reason, in safety factor provided, for use elsewhere. A single transmission line of less than 100 miles in length may easily pass from high, clear mountain air to foggy, dusty surroundings which are a constant menace to continuity of service. Again, the cost of complete immunity may well be balanced against cost of possible shut-downs, a point well illustrated in many present transmission lines in which branch lines are equipped with much smaller and consequently cheaper insulators than those upon main lines.

It is not intended to convey the idea that every line should have a special insulator, but that the characteristics of the proposed line should be made known to the designer in order that all points may be well guarded against. It is quite likely the resulting recommendation will be upon an old established type of which all characteristics are known, and though its use for any specific case may not call into use all it is capable of, it will quite likely prove cheaper to produce a standard article of larger size than to make a special design of just sufficient capacity.

A forecast of the future of any business, though never safe, is always interesting.

Concerning the highest practicable voltage, without reference to anything but insulators, it is safe to say that insulators for the heaviest mechanical strains and for the highest electrical stresses can be manufactured at moderate cost, so that limitations of transmitting voltages must at the present time be looked for in other directions than in insulator design, porcelain insulator design in particular.

CIVIL SERVICE EXAMINATION FOR ELECTRICAL ENGINEER.

The United States Civil Service Commission announces an examination, on November 9, 1908, to secure eligibles from which to make certification to fill a vacancy in the position of electrical engineer in the Technologic Branch, Geological Survey, at a salary ranging from $1,620 to $3,000 per annum, according to the rating received, and vacancies requiring similar qualifications as they may occur.

It is desired to secure persons who have had broad training and experience in electrical engineering, especially in connection with coal mining operations, and who will be fully qualified to undertake original investigations into the conditions under which electricity may be safely used in coal mining.

The examination will consist of education and technical training, including post-graduate work; technical or professional experience in electricity as applied to coal mining, and experience in general electrical work.

CORPORATION REGULATION.*

By John A. Britton.

The position occupied by public service corporations in the mind of the public is not, as may be first believed, so much due to the attitude of the daily press, as it is to the original sins of the corporations themselves, which were, it must be confessed, in many instances equivalent to the action of get-rich-quick concerns, and which gave the opportunity and excuse for the present attitude of the press.

The daily press has, because of the license allotted to it, under the guarantee of our Constitution, become not alone a censor for the public, but occasionally a misleader of public opinion. It attempts and very often succeeds in becoming prosecutor, judge and jury, trying a case on misstatement of facts and rendering a verdict according to its personally distorted views, either for self-aggrandizement or to curry favor with certain political interests inimical to corporations; it will rarely, except in its advertising columns for pay, give the corporation side of any argument, and the public is for 365 days in each year treated to a one-sided dissertation on the graft and greed of corporations and its managers, who are held up to ridicule and scorn by the facile pen of the editor and reporter and the equally graphic pen of the cartoonist.

For all of this pilloried condition the present corporations and their predecessors in interest have themselves so largely to blame that a new method of treating the public must be created to restore them to the favor in which they were once held.

Less than half a century ago public service corporations were regarded as the saviors of their country. Then they were few in number and largely were controlled by the people themselves, who found in them means of husbanding their surplus resources and of adding thereto by the natural accretions of a business which was permitted to realize the same profit that all other industries were permitted to do without let or hindrance.

As pioneers of enterprise intended primarily for the public good and welfare of communities, they were accorded privileges in accordance with their importance, and their managerial heads were men of honor and importance in the community, sharing in high civic honors and positions of prominence in municipal affairs. Their rates charged were not questioned, and, as became a legitimate industry, were reduced as the broadening of their field produced new inventions and appliances to cheapen their product. Then, as the wealth and population of the country increased and the enterprise of serving the public became more and more profitable, it incited others to enter the field, who, too timid to make the initial venture, were not too bold to become imitators and competitors, and a surfeit necessarily arose, especially in the plants of gas and electric industries; competition harsh, cruel and detrimental to capital invested, and equally so to the public, by the giving of rates which yielded no profit to the giver, forced consolidation, and thus were committed some of the original sins, against which have grown others from time to time as fungus to the sturdy oak, throttling growth and killing enterprises. All of these sins have made possible the popular, administrative and executive attacks, and as by the aggregate name of corporation are classed all, the innocent must with the guilty bear the burden of public defiance and contumely.

Here in the State of California, golden in her promises even to corporations prior to 1879, reaction thus commenced against one corporation, because of fancied wrongs, but mainly because of a jealousy of the rapidly acquired wealth of a few hardy pioneers, who dared to do what others would not even attempt, and a new constitution was born and bred on the sand lots of San Francisco, nurtured in the lap of anarchy and obtained sustenance at the breast of socialism, but after being brushed into shape by conservative men was adopted as the Magna Charta of this State, and in a few years thereafter there was exercised under it the first regulation of water, gas and electric rates. The particular provision in the constitution relating to gas and electric rates and adopted in 1884, reads as follows:

"In any city where there are no public works owned and controlled by the municipality for supplying the same with water or artificial light, any individual, or any company duly incorporated for such purpose under and by authority of the laws of this State, shall, under the direction of the Superintendent of Streets, or other officer in control thereof, and under such general regulations as the municipality may prescribe for damages and idemnity for damage, have the privilege of using public streets and thoroughfares thereof, and of laying down pipes and conduits therein, and connections therewith, so far as may be necessary for introducing into and supplying such city and its inhabitants either with gas light or other illuminating light, or with fresh water for domestic and other purposes, upon the condition that the municipal government shall have the right to regulate the charges thereof."

From this section you will observe the power given to municipal bodies to regulate our industry—a power of absorption, or of confiscation, or haply of a higher and greater use, that of increase of value of properties involved. It commits to the hands of men elected by the people to hold office for a brief period of days, judicial authority to be exercised over properties amounting to millions, puts it in their power to create or destroy, forces finally the issues involved into endless litigation, creates distrust in the minds of the people, gives the press an opportunity to inflame the mind of the public, and accomplishes in the end, nothing. What, let me ask, can a body of men chosen from the masses, know in the generally farcical investigations made, of the detail of a business that calls for the highest skill in finance and engineering? Can two hours a day for three days solve these grave questions? Can a legislator come to the trial of this case in an unbiased frame of mind? Does he not owe allegiance more to the constituency which he represents than to the company whose case he is trying? Does he not regard with fearsome awe the clamor of the press, not to heed the vaporings of the corporation, which is trying to rob the people, but to cut their prices and their profits? Does not all of this place him in the attitude, perhaps, unwittingly, of a prejudiced juror, so that his verdict intended to be obviously fair, becomes a weird, distorted one, recreant to the truth of the facts brought out? It is not asking too much of that citizen, who, for a meagre compensation, must give his time from his own affairs, to consider, carefully and judicially, such grave questions as involve the welfare of millions of other people's money. Therefore, a remedy for this very inequitable method of dealing with these properties must be evolved, and the purpose of this paper is to suggest some way of accomplishing this object.

The day has gone into the night of darkness when reasonable, farseeing and deep-thinking corporation men, object to the proper regulation of corporations. Regulation is needed for protection, for without it, each corporation would be at the mercy of as pitiless a pack of howling destroyers, as would the lonely traveler in the Siberian steppes, be against the gaunt and hungry wolves. Aggregations of wealth centralized, become too great a power for evil to be permitted to exercise its own prerogatives; it needs the same directing hand that a turbulent, sturdy boy needs as he grows to manhood to direct into proper paths, so that his growing strength may be made of the greatest good.

The law makers of our country, confronted in the short terms of their office, with great problems of state, have neither time, patience nor opportunity to legislate for such control as is needed, but should only be empowered to delegate to an executive body specially organized for that purpose, such regulation and control after a calm, and unbiased presentment of the case as each issue becomes involved. Massachusetts, New York and Wisconsin have set the pace for California and all other States. Commissions there created have restored confidence in corporations, have

*Paper read at Sixteenth Annual Convention, Pecific Coast Gas Association.

restored the confidence of investors in them, have set the mark of peace on the distracted brows of the public, and have made it possible to insure an earning capacity on money invested in their midst. Mooted questions of right or wrong are settled in calm deliberation and not in political heat; the consumer has at all times a friend at court and the press is powerless to wreak its vengeance and must, of necessity, in the absence of opportunity to abuse, perforce engage in a campaign to better and uplift. Thus in these States has come for the corporation men, that millennium which means rest from the incessant latter day trials of striving to pacify the minds of inflamed partisans.

With proper regulation of corporations will come the much hoped for demise of that unreasonable demon and destroyer—Municipal Ownership, the product of unregulation and corporate greed, and the political charnel house in which is stored the whitening bones of constituents, and hungry politicians, who, becoming holders-on to the teats, milk dry the unwilling breast and who, dog-in-the-manger like, allow no others to feed.

There is needed in California a facing bravely of the existing conditions, an acknowledgment of past errors and a promise of amendment to achieve that desideratum, the creation of a Board of Regulation, which means removal of rate questions from its present domain of inefficiency, and indifference to the destruction of property, and to the violation of the Fourteenth Amendment of our National Constitution.

Corporations may be as was Caesar's wife, above suspicion; they may cater to and endeavor to obtain the good will of patrons, may sell their product on just and equitable bases, may make their employees profit sharers, may spend millions in pacifying by all these means and more the clamor of the people, but so long as annually they must submit to and abide by the votes of a municipal body as to what they shall or shall not charge, so long will an unholy warfare against them be waged by the few who in this land of plenty speak for the many. Good will cannot be created in favor of corporations by the Corporations' good deeds, for they are forever misunderstood and misconstrued, and the only remedy is to invest the power of regulation in the hands of men trained in the arts and science of the industry with no political axes to grind, and men appointed for a term of years and at a compensation sufficient to guarantee the selection or election of qualified men.

To do this in our State will require an amendment to the Constitution, taking it out of the power of municipal bodies, and vesting it in a commission appointed by the Governor, not a commission of infinite powers over all kinds and characters of corporations, but one specifically to control lighting companies, such a one as has proven to be thoroughly competent to serve both the public and corporations as has the Board of Gas and Electric Commissioners of Massachusetts.

REJUVENATION OF THE SONS OF JOVE.

At a rejuvenation of the Sons of Jove, held in San Francisco, at Solari's Grill, on Saturday evening, October 10th, the following members were initiated:

Alvord, Maymond Martin; Berry, William Shelby; Bowden, Robert Andrew; Davis, Curt C.; Fagan, Frank E.; Gregory, Silas Barber; Goldrick, Harry Cumming; Harris, David Edward; Lyman, Frank Thomas; Levy, Louis; Oakes, Roscoe Forrest; Poss, Edward Daniel; Russell, Samuel Price; Scott, Charles Winfield; Thelen, Charles Joseph; Vandercook, Arthur Blaine; Van Huysen, John William; Woodward, Francis Henry. After the initiation ceremonies had been completed, an enjoyable banquet was served, presided over by the Jovian statesman, Mr. T. E. Bibbins.

MODERN METHODS OF HEATING.*

By. H. R. Basford.

Mr. President, and fellow members of the Pacific Coast Gas Association: In appearing before you to-day I feel that an unusual opportunity has been presented to me, and of my appreciation and deep gratitude I will have you all believe.

My remarks will distinctly travel along the commercial side of the gas business. In elucidating the facts concerning automatic gas water-heating, devices, I will confine my remarks to a recital of historic facts in connection with this universal line and their performances, and consequent bearing upon the commercial side of the gas industry.

The Instantaneous Automatic Water Heater had its birth in Pittsburg. Some twenty years ago, when natural gas was first commercially applied, it created a very wide field for all manner of gas consuming devices, and inventors naturally sought to take advantage of the situation in the perfection of numerous and diverse appliances for all manner of domestic and industrial application of this cheap and abundant fuel. So it was that in 1887 and 1889 that Mr. Edwin Ruud became identified with Mr. George Westinghouse in the Fuel Gas & Manufacturing Company. The primary object of this company was to search means and ways whereby it would be possible to produce a fuel gas at a moderate price, and in conjunction with these experiments the development and perfection of all manner of domestic and industrial gas consuming appliances.

At the time mentioned, a satisfactory, dependable hot water service for the modern home was well nigh impossible, and if at all obtainable was only at great expense and through the medium of crude and troublesome devices. Naturally this field was very broad, and inventors were quick to seek a newer and highly improved method of satisfying the rapidly increasing demands made upon them and a general desire for higher refinement in the home.

After careful and elaborate experiments the application of a thermostat to a gas water heating device was first accomplished. The product at this time consisted of a tubular boiler, and the fuel controlled by the thermostat through the temperature of the water. While the construction was very crude, the heater was very efficient, though expensive, and while it satisfactorily fulfilled its object, its field was narrowed by the first cost. When this became evident, and the sale of heaters was restricted from these causes, the thermostat was successfully applied in connection with a continuous copper coil heater. The early types were of the same general construction as the present heater, so far as the application of the principles is concerned. The well known staggered coil was brought out, the thermostat being located in the heat zone at the bottom end of the coil. This principle has been religiously adhered to ever since, and to this in no small measure is due the phenomenal success of the automatic gas water heater.

This new type, being considerably less in first cost, and possessing a higher efficiency, rapidly won its way in the natural gas field, but quite a few years elapsed before any concerted effort was made to apply this construction to manufactured gas.

Improvement and further refinement of the principle went on, however. Experience brought out each difficulty, and the inventor's skill overcame them, with the result that in the year 1902 the first automatic gas water heater for manufactured gas was perfected and made ready for the market.

*Paper read at Sixteenth Annual Convention Pacific Coast Gas Association.

In the short space of six years the then comparatively unknown device has grown to be a by-word in tens of thousands of homes in the United States, and has overcome the first prejudices of the gas men, and has come to revolutionize the present standard of living, so far as economical and satisfactory hot water service for the household is concerned.

We have now sketched the interesting and phenomenal growth of the automatic heater. We shall now dilate upon it as we see it to-day, its service to the user, its value to the gas company, and the breadth and extent to which the first mechanical principles of the heater have been broadened, and circumvented the entire field of water heating in all its branches.

We are all familiar with the development of the gas range, the telephone and electricity. Each has fought and won the prejudices and skepticisms of its age, and to-day there is not one of us but what accepts each as a reality, and indispensable to modern home living.

The automatic heater, like every other revolutionary force, has just about overcome the prejudices and skepticisms of its age, and to-day is accepted as a necessity in the modern home. To a thorough understanding of this remarkable heater and appreciation of its qualities we must now undertake its analysis.

Fundamentally, a water heater is a combination of three essentials, so co-related as to produce certain results and yet maintain a consistent relation to one and the other and the whole. The essentials of an automatic water heater are a burner, or battery of burners, heating surfaces, and an automatic controlling mechanism. The many details that relate to these principals are insignificant in the abstract. Taking the several principals in the order mentioned, we will trace the evolution of the Ruud base burner.

We hardly need remark that the development and perfection of a successful gas burner to meet the exacting requirements of an automatic water heater was undoubtedly the most difficult problem to overcome.

The burners are all of the Bunsen type, having a construction differing widely from any heretofore produced. There are several types of these burners, all more or less successful. Many different ones have been tried, but it is the general practice now to use a burner from which the flame burns straight off the top. The burners are made with two plates, separated but held together by brass bolts.

Between the pieces is placed a perforated copper plate, which is used as a flame check. The flame starts from the corrugations, running along the top of the burner. The peculiar construction prevents to an infinitesimal part, the possibility of condensation entering the burner proper and causing any stoppage in the perforations of the flame check, and bear in mind that no successful burner for an automatic water heater is possible without this flame check. The flames as they start from the burner are inclined inward, thus confining the flame to the center of the coil, which is in turn deflected by deflecting plates held in the coil.

The construction and manner of placing the burners allows good circulation of air around the same, thus keeping its temperature at the lowest possible point. The burners are arranged in a battery on a circular ring, and when in operation produce a continuous sheet of flame, without one impinging against the other.

There are some variations in the burner, which are now and then found necessary to handle various gases, and this is accomplished by the adjustment of the gas orifice and the perforated copper flame check. Some of these burners have been brought to such a high state of perfection that it is possible to operate it continuously for hours without any fear of backfiring.

The next step is the material employed for heating surfaces, and their arrangement. The staggered double cone-shaped copper coil wound in series has been so successful that it is now recognized as the only means of arranging the heating surfaces to obtain satisfactory efficiency. The copper tubing is obtained in suitable regular lengths, in accordance to the footage that may be placed in any one size. As an illustration, will mention the No. 4, which contains one hundred lineal feet of seamless copper tubing, consisting of four 25-foot lengths. These lengths are first coiled up into double cones, and then brazed together. The inside diameter of the smallest coil is about six inches. This space is occupied by a cast-iron deflecting plate, which prevents any center draft on flame, and has a tendency to distribute the flame over the surfaces successively exposed above.

The material employed is seamless cold-drawn copper tubing made from the purest copper obtainable, and tested to withstand a hydrostatic pressure of one thousand pounds.

The automatic mechanism might be called the brains of a water heater. It is upon this part that we must depend for reliable response to the opening and closing of the faucet.

The mechanism of the heater is made in duplex, consisting of a simple upper gas valve, which is controlled entirely by the water-pressure valve, and a second gas valve which is controlled entirely by the temperature of the water.

The water valve is so devised that when you open any hot-water faucet in the house, the pressure of the water passing through same will cause an opposite gas valve to be opened. The construction of the water valve is such that it can be applied universally to any and all pressures and kinds of water, and be relied upon to fulfill its function.

Even though this valve has now been perfected, it is still recognized to be subject to certain influences impossible to guard against the likelihood of gravel or other foreign substances passing into same, and possibly destroying temporarily its function. A water heater, depending entirely on a pressure water valve for its control, is a marketable impossibility, since it cannot be said to be reliable, but a water heater possessing an internal thermostat operating in conjunction with a water valve can be called absolutely perfect, since it is able to take care of itself under any and all circumstances. The employment of the natural law of contraction and expansion of metals under change of temperature, is manifest in the construction of the thermostat. This device is nothing more than a piece of copper pipe, which is employed on account of its sensitiveness to change of temperature. The thermostat tube is connected solid into what is termed the "water head." Within the copper tube is a porcelain rod, which acts as a motion piece, communicating the action of the copper expansion tube to the levers opening and closing the gas valve. Surrounding the copper tube is a 1¼-inch brass jacket through which the water passes. The water enters the heater at the top, travels downward the entire length of the coil, and thence across the fire through the thermostat jacket. Thus you will see that the copper tube is at all times submerged in the water while flowing or still, and that this brass jacket is exposed to the flame from the burners. We will now assume that the heater is in operation, and as the water in the coils heats up, the thermostat tube begins to expand under the increasing temperature, and will continue to expand until the flowing water has reached a predetermined temperature, when the flow of gas will be reduced, and possibly shut off altogether. If we increase the flow of water through the heater, or continue to draw the same amount as we did at the start, the water removed from the coil will be replaced with colder water, and the thermostat tube will be chilled and contract, which will result in the thermostatic gas valve being opened, gradually emitting the full flow of gas. This process continues intermittently while the heater is in operation. Here we see that it is impossible to burn any more gas than is actually required to heat the amount of water drawn to a predetermined temperature. We have an even temperature in the water we are drawing, and should the water valve for any reason be hung up, we see how the heater will take care of itself, because the thermostat being exposed to the flame will allow the heater to burn only long enough to increase the temperature surrounding the thermostat to cause it to expand and close the valve through which the gas

passes to the burners. This arrangement, which, as will be seen by the process of reasoning above mentioned, positively insures reliable action under any and all circumstances.

We have analyzed in an extended way the successful and fundamental features of an instantaneous automatic gas water. Many details more or less unique in their way, and of considerable importance, to the three principals discussed, might be touched upon, but do not lend themselves to comprehensible discussion.

The development and success of the instantaneous automatic water heater soon inspired inventors to broaden the field of operation, and endeavor to supply the gas fraternity with that long sought for means whereby they could successfully enter the larger field of gas water heating. Within the short space of two years prior to this date, a satisfactory gas storage water heater was not obtainable in the market, with the result that many large residences, apartment buildings, hotels, office buildings, gymnasiums, and many other classes of special institutions were beyond the reach of the gas man, and he suffered to see this rich field in the exclusive control of the coal king. With the invention of certain mechanical devices, all this has now been changed, and through the medium of the multi-coil storage system we have at one stroke made it possible for the gas company to successfully seek contracts for heating water in any and every class of building, diverting to his coffers a large revenue that heretofore was not thought obtainable.

Having developed a successful burner, one that could be depended upon for continuous firing, there was evolved the now well-known multi-coil construction of the heating surfaces. With this combination we had a perfect circulating storage water heater, but the means for automatically controlling the fuel in such a manner as to give the burners the greatest relief, there was invented a marvelously effective and ingenious mechanism. By this valve it was made possible to eliminate the great heat losses that took place from radiation and convection, and brought within a moderate operating cost an automatic gas storage system.

We will give a brief description of the operation of the system. Storage tanks of any given size are installed with single heaters or in duplex, and in very large installations the capacity is expanded to three and sometimes to four. The thermostatic moment valve is installed in the tank, and responds to the temperatures of the water in the tank. The heaters now going into operation will work continuously until the tank is filled with water to a predetermined temperature, as arranged by the adjustment of the thermostat. When this temperature is arrived at, the moment valve automatically, and by a snap action, closes off the full supply of gas to the heaters. Circulation then ceases in the coils of the heater, thus eliminating the extremely high losses from radiation and convection. The tank being thoroughly insulated, the heat losses are practically nil, and during the long periods when water is not drawn, no gas is burned in the heaters.

During such times when water is drawn, possibly one-third may be taken from the tank before the temperature of the whole has been so altered as to cause the moment valve to turn on the supply of gas, this valve being so devised that it operates within a range of 25 deg. The operation repeats itself.

We can point to numerous installations in large residences, flat buildings, hotels, and many other special classes of buildings, which under any other circumstances would not be possible gas consumers for water heating. This new system has accomplished and made complete the facilities of the gas company for enjoying the larger revenue that comes from supplying this appliance for large operations.

While we could quote at length many large installations, we take great pride in mentioning one especially, the largest that has heretofore been undertaken. In Chicago there is under way the construction of numerous public bath houses, and it is devised to use gas for heating the water. In these bath houses Multi-Coil Storage Systems are employed, the installations each being of 1500 gallon boiler capacity, fitted with three 500 gallon per hour Multi-Coil Storage Heaters. Considering the very heavy consumption of water that will take place, I leave to your own judgment the revenue that likely accrues to the gas company from these installations, and it must be your inevitable thought that in the perfection of this storage water heating plant a great advance has been made, which will be of ultimate great service to every one interested in the commercial side of this fascinating industry.

House heating from manufactured gas on any extended scale has heretofore been well nigh impossible. It may surprise some of you to know that the Multi-Coil Hot Water House Heater, which is an elaboration of the Multi-Coil Storage Heater, for more than the past year, has been successfully applied in the field of heating houses by hot water circulation, using manufactured gas as fuel.

This type will wonderfully extend the scope of the gas fuel department.

We cannot but feel that each of you recognize the full importance of these accomplishments that have distinctly revolutionized and wonderfully expanded what heretofore has been a narrowed field of operation in so far as manufactured gas was applied to heating water for the purpose in the sense of utility, comfort and convenience.

It might not be amiss to state that the field in which these devices are being operated is still incomplete, and that the further refinement of the product, and the developing and broadening of its application is in a constant process of evolution, and it is our hope that with your same helping hand which has assisted heretofore in the fruition of these ideas and their application, may be enjoyed in the future.

Will mention a few of the fields in which these heaters are being employed that are not generally known, and which will show you what a wonderful help they are toward opening avenues heretofore closed to the gas companies:

1st. Superheating steam to increase temperature without increasing pressure in the rolls of the textile mills in Philadelphia.

2nd. Keeping steam in the boilers of fire engines which are lying idle in the firehouses.

3rd. Pasteurizing wine.

4th. Cooking sherry wine.

5th. Furnishing hot water for curing barrels in barrel factories.

6th. Heating swimming pools.

7th. Sterilizing beer.

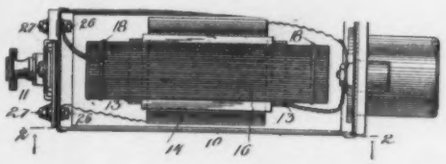
8th. Where large quantities of hot water are required for manufacturers' use as soon as work begins, in the morning, and at the same time, to be able to do away with a night engineer.

BOOKS RECEIVED.

"Heating and Ventilation," by Chas. L. Hubbard, is a reprint of that portion of Volume VI of the Cyclopedia of Engineering, published by the American School of Correspondence, pertaining to this subject. It covers the general field of heating and ventilating very thoroughly. After a brief discussion of the systems of warming and principles of ventilation, the author presents tables and factors for determining heat losses from buildings. The various systems are then taken up more in detail, and illustrations of typical apparatus are used to explain the text. The outline drawings and illustrations of the direct systems are modern and very good, although no mention is made of the gas furnace, which has proved very satisfactory on this coast. Some of the cuts in the indirect system are of obsolete apparatus as now manufactured by the leading fan makers, and cuts of new and late models are lacking. For a general survey of the entire field the book meets the requirements admirably. For sale by the American School of Correspondence, at $1.50.

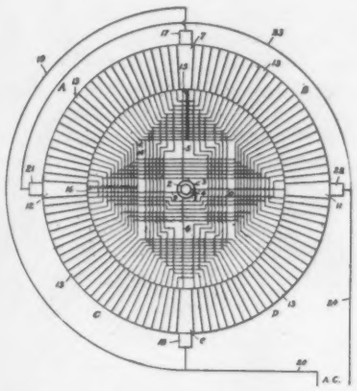
PATENTS

HIGH-POTENTIAL SPARK-COIL. 899,634. Chester H. Thordarson, Chicago, Ill.



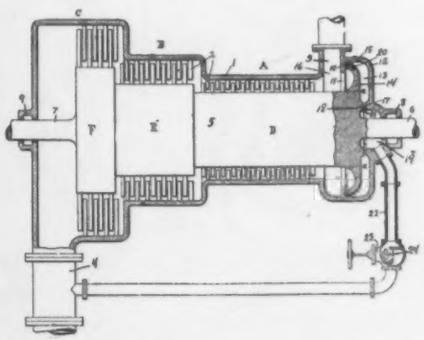
A high potential spark coil having a primary and a secondary winding and a core therefor, core having an air gap in its magnetic circuit, a casing for wholly inclosing windings and core, and a movable armature arranged outside the casing and at a point adjacent air gap.

CONVERTER. 899,629. Harry Shoemaker, Jersey City, N. J., assignor to International Telegraph Construction Company.



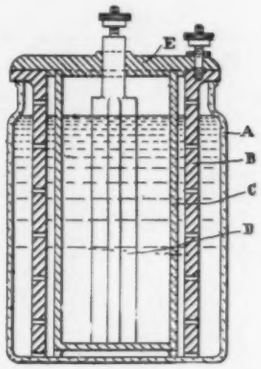
The combination with a converter, of a plurality of commutator segments, resistances in varying amounts connected between commutator segments, brushes bearing upon segments, and means for supplying direct current to segments at symmetrical points.

TURBINE. 899,559. Arnold Pfau, Milwaukee, Wis., assignor to Allis-Chalmers Company, Milwaukee, Wis.



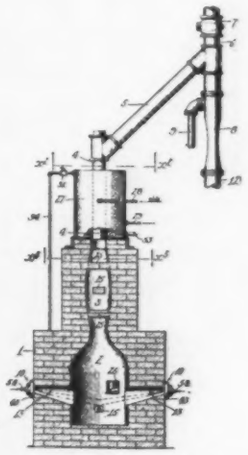
The combination with a casing, of a spindle rotatable therein, spindle being provided with a piston, casing being provided with a second casing and an abutment whereby a chamber is formed, piston being located in said chamber and movable to approach or recede from abutment to permit the steam to act upon one side thereof to force the spindle in one direction or to act upon both sides thereof to equalize the pressures exerted upon both sides of piston, spindle being provided with an end surface that may be exposed to steam under pressure when the pressures of the steam on opposite sides of piston are equalized.

PRIMARY BATTERY. 899,823. Wilhelm A. F. Bleeck, Brisbane, Queensland, Australia.



A double fluid primary battery consisting essentially of zinc as the positive element in a solution of sodium hydroxid as the excitant and of carbon as the negative element in a depolarizer consisting of chromic acid dissolved in a solution of hydrogen peroxid with the addition of hydrochloric acid, the depolarizer being separated from the excitant by a porous partition.

APPARATUS FOR PRODUCING GAS. 900,010. Joshua J. Nix and Warren H. Frost, Los Angeles, Cal.



An apparatus for producing gas from liquid hydro-carbons, comprising a vertical chamber open to communication with the outer air, burner means adjacent to the bottom of the chamber to heat the same internally, means for admitting hydrocarbon to the chamber between the bottom of the chamber and the heating burners and suction means connected to the upper part of the chamber to withdraw gas therefrom.

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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The Potter's Wheel

It is interesting to note in the article on the manufacture and testing of insulators by Mr. H. N. Noack, in this issue, that the potter's wheel is still an important factor in clay working. Notwithstanding the wonderful achievements of modern progress, this ancient utensil continues as one of the essentials of procelain fabrication. The advancements in this great industry consist in the making of a compound that is not only mechanically strong but also able to withstand the great electro-static stresses set up by high tension currents utilized in recent power plant systems.

Corporation Regulation

Agitation and antagonism toward a public service corporation retards not only the progress of the corporation but also the benefit of the community it serves. One beneficent result of the Public Service Commissions recently appointed in Massachusetts, New York and Wisconsin, has been the credible publicity which shows both phases of a hitherto one-sided argument. By means of these Commissions public interests are protected and corporate stability ensured; restoration of confidence allows further extensions of public utilities needed by the community, and the name corporation can become synonymous with co-operation for the advancement of the general welfare. In all this the corporation and the commonwealth are to be considered.

A system of State regulation under the direction of a board at once impartial and competent, need not in any way reflect upon the character of municipal control. Rather should it be regarded as a higher court of arbitration, whose members are better able through their wide experience to deal equitably with all questions submitted for their decision. Municipalities can rarely afford to maintain a board of high salaried men whose abilities can be devoted exclusively to the solving of such problems, but the aggregate of work throughout a State is usually sufficient to keep them constantly employed.

It should be borne in mind, however, that **regulation** does not imply **operation.** A pendulum is an excellent regulating device for a clock, but without some driving mechanism, such as a spring or system of weights, the clock would soon stop. A Public Service Commission in its legitimate function as a regulator of rates and a restrainer of over-capitalization is an excellent institution, but experience has shown that a highly specialized business can be more economically conducted by private interests.

RESOLUTION FOR THE ENCOURAGEMENT OF RIGHTS OF WAY FOR ELECTRIC POWER COMPANIES.

After a lengthy discussion the following resolution, presented by Judge Frank H. Short, of Fresno, California, was passed at the Trans-Mississippi Congress held last week at San Francisco:

"This Congress recognizes the growing importance of the development of electric power, not only for the purposes of lighting, manufacturing, and commerce, but also in aid of irrigation by pumping from subterranean sources. Developments already accomplished in this direction warrant the assumption that, in the not far distant future, the lands irrigated by water pumped from such source will equal, if they do not exceed, lands irrigated from the natural flow of streams. The development and use of our streams for the generation of electric power not only aids and increases irrigation directly, but is beneficial in many other ways. First, it renders possible and profitable the construction of reservoirs in the high mountains withholding excessive floods, thus aiding reclamation and also conserving this injurious flow which is later added to the beneficial flow of water available for irrigation. Second, it is the one great source of supply immediately available for lighting, heat and power as a substitute for other fuels, thus limiting the rapid destruction of our forests and also conserving and saving our supplies of coal and other fuels. Third, the use of electricity for pumping renders it possible permanently to reclaim and irrigate vast sections of our arid land otherwise impossible of reclamation or irrigation. Fourth, its extensive development will cheapen and extend manufacturing and commerce, thus affording an immediate home market for the products of our irrigated farms and also cheaper transportation to other markets.

"Therefore, Be It Resolved: That the necessary rights of way and rights for the construction of reservoirs, and other uses of the public lands, for the development of electric power should be aided and encouraged in every reasonable way; and no burdensome charges or discriminations should be exacted or imposed, as a result of which such beneficial developments may be delayed and the investment of capital therein prevented and the cost increased to the consumer. Such uses, being public uses, should be controlled and regulated by the State or nation, as the situation or use may require."

PERSONAL.

W. W. Briggs, district office manager of the Westinghouse Electric & Manufacturing Co., has returned to San Francisco from an Eastern trip.

C. I. Crissey of the Department of Commerce and Labor, Washington, D. C., has been gathering data on western hydro-electric power plants.

Allen L. Hasse ("Bracket Al") has resigned as sales manager for Pierce brackets, to join the Harvard Electric Company, 66 West Van Buren Street, Chicago, and 136 Liberty Street, New York City, as general sales manager.

Frank E. Corwin, of the Bryant Electric Company's San Francisco office, returned, early this week, from a trip in the Northwest, including Seattle and Portland, and reports improved business conditions and a very cheerful feeling generally in that section.

W. I. Otis, of Messrs. Otis & Squires, San Francisco, has returned from a very successful and extensive business trip which included practically every point of importance in Southern California. He reports conditions much improved and the outlook for fall and winter business encouraging.

TRADE NOTE.

A. C. Thode has been given the contract for the electrical work of the Milwaukee Brewery in San Francisco.

WOODPECKERS DESTROY TELEPHONE AND TELEGRAPH POLES.

Birds are destroying the telephone and telegraph poles in the South and Southwest, particularly in Texas, Arizona, and California. In some places fifty per cent of all the poles along the right-of-way have been riddled by these innocent offenders, which belong to the woodpecker family. One of the Western Union officials, who has recently returned from an inspection through the West, reported having seen twenty-five telephone poles with two or three hundred holes drilled clear through them. Some of the holes were three or four inches in diameter.

An officer of the Illinois Central Railroad counted the white cedar telephone poles along the right-of-way near Covington, Tennessee, which had been affected by woodpeckers, and found that out of 268 poles, 110, or 41 per cent, had been bored. In some cases destruction of the pole takes only a few months and the weakened condition makes it dangerous for a lineman to climb the stick.

The real object to the birds in drilling the holes is uncertain. One telephone man said that the humming of the wires was mistaken by the birds for insects excavating beneath the surface of the wood, and that they drilled the poles in quest of these imaginary insects. It is very probable, however, that the holes are excavated for an entirely different purpose. The woodpecker is a provident bird. At the proper season it stores up a supply of acorns and other foods for future consumption. In the summer these holes are often found stored with acorns.

Many methods for preventing this damage have been suggested, but probably the most successful is preservation with creosote. A line of creosoted poles, opposite the one near Covington, was examined, and not a single hole was found. When it is considered that creosote will not only prevent the damage caused by the woodpecker, but also protect the pole indefinitely against both insects and decay, its great value as a preservative is apparent.

The Forest Service has spent considerable time in developing a cheap yet efficient method for the treatment of telephone and telegraph poles. The results of the work are embodied in several Forest Service circulars, copies of which may be obtained without cost from the Forester, Washington, D. C.

TRADE CATALOGUES

The September issue of "Holophane," from the Holophane Company, of New York, contains some excellent suggestions for economical lighting, including one on the lighting of a hotel dining room.

In Bulletin No. 4618, just issued by The General Electric Company, is described the Form P B polyphase generator for use in small power plants and isolated lighting plants where rapidly-increasing inductive loads, and consequently low power factors, are encountered.

Bulletin G from the Lea Equipment Co., 136 Liberty St., New York City, illustrates a line of high-duty turbine pumps designed for heads from 7 to 1000 feet or higher, and capacities ranging from 75 to 30,000 gallons per minute. It includes full details of a series of tests that show high efficiency.

Northern Type "S" Motors are illustrated and described in Bulletin No. 59 from the Northern Electrical Mfg. Co., of Madison, Wisconsin. This motor represents the latest advance in the design of a practical and efficient adjustable-speed motor for all classes of mill and factory service. This type is built open, semi-enclosed, and enclosed.

The General Electric Company has just issued an attractive booklet descriptive of its "Multi-catch Socket." This socket is primarily intended for fixture work, although it may be used wherever the standard socket is used. This socket contains also the new General Electric center contact, the advantages of which together with the chief characteristics of the socket are described and illustrated in booklet No. 3700.

INDUSTRIAL

BATTERY CHARGING PANEL.

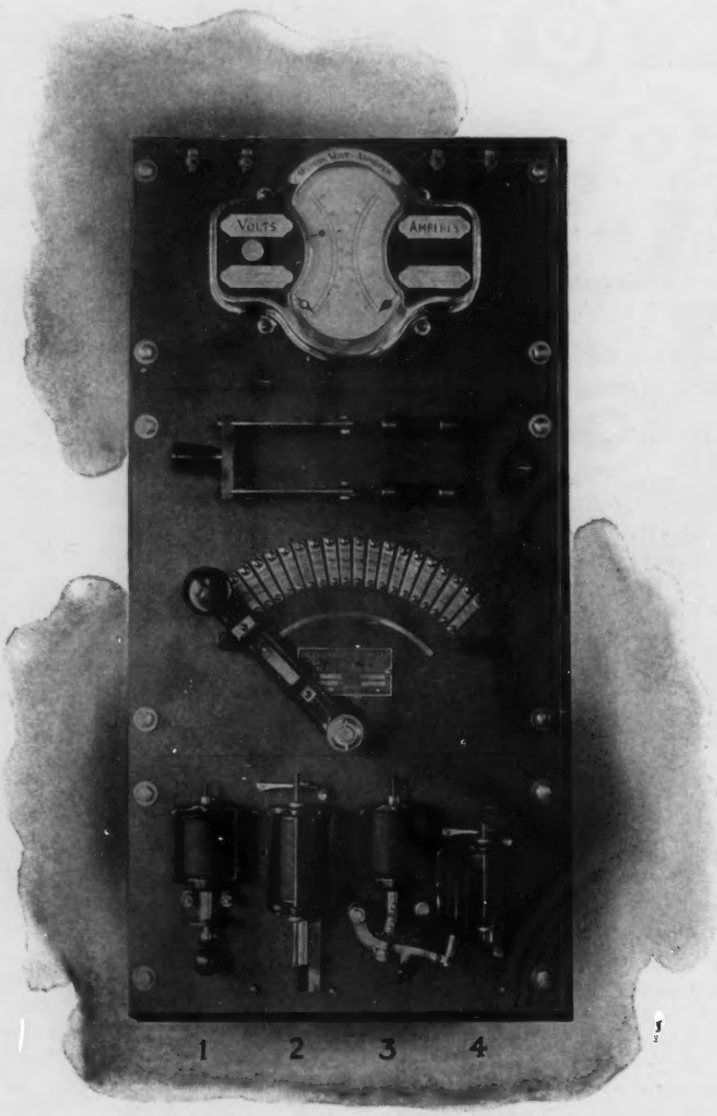
The demand for a battery charging panel which shall not only meet all requirements of battery charging service, but which shall possess automatic protective features as well, has led to the development of the panel here illustrated—Type E. The panel itself, which carries all of the operating mechanism and protective devices, consists of three separate pieces of slate. On the face of the uppermost slate are mounted the terminals, or binding posts, and a Weston volt-ammeter. The middle slate carries a double pole knife switch and fuses (National Electrical Code Standard) and below these the contact segments and operating lever, by means of which the charging current is regulated. On the slate at the bottom of the panel are mounted the automatic, protective devices, which are:

(1) A low current cutout which automatically opens the circuit if the current drops to a predetermined minimum. This prevents the battery from discharging into the line should the line voltage drop below that of the battery.

(2) A maximum voltage cutout. This automatically opens the circuit when the battery voltage reaches the point at which the cutout is set to operate.

(3) A solenoid switch, the opening or closing of which "breaks" or "makes" the main line charging circuit.

(4) An overload circuit breaker which automatically opens the circuit if the charging current rises to the point at which the breaker is set to operate. This insures the battery against being charged at an excessive rate.



Cutler-Hammer Battery-Charging Panel.

The operation of this type of battery charging rheostat is as follows: After the battery and line connections have been made, the operator first closes the knife switch and then moves the operating lever forward to the third contact segment, at the same time raising the plunger on the low current cutout (1), thus energizing the solenoid switch (3) which closes and permits the charging current to flow to the battery through the resistance.

If at the beginning of the charge the operating lever is not in the starting position (that is to say, resting against the rubber stop-post at the left), it must first be brought to the starting position and then moved to the third contact segment as described above. It may then be moved further and further to the right, cutting out one step of resistance after another and increasing the amount of current until the desired amperage (as indicated by the ammeter) is obtained.

Should the current fail, or reverse, the low current cutout (1) will release its plunger, thus de-energizing the solenoid switch (3), which will in turn open the main circuit. Should the charging current reach the point at which the overload circuit breaker (4) is set to operate, this will open the main circuit. Finally, when the charge is continued until the battery reaches the voltage at which the maximum voltage cutout (2) is set to operate, this will automatically open the circuit, thus insuring the battery against an overcharge.

It will be evident, from the above description that the use of this panel protects the battery under all charging conditions, as it not only guards against an excessive charging current, but also prevents the battery discharging back into the line should the line voltage fall below the voltage of the battery. It posseses, moreover, the advantage of requiring no attention after the charge is once begun, since the maximum voltage cutout (2) will cut off the current of itself when the battery is fully charged. As an additional protection, the operating lever is provided with an electrical interlock which prevents the operator from closing the circuit to the battery except when the lever is in the "off" position, that is to say, with all resistance in circuit.

This panel as illustrated and described is manufactured by the Cutler-Hammer Mfg. Co., of Milwaukee, Wisconsin. Otis & Squires, 113 New Montgomery Street, San Francisco, are the local representatives.

"Telephony," published at Chicago, now comprises "Telephony," "American Telephone Journal," "Sound Waves," "Telephone Magazine," and "The Telephone," being issued weekly.

ILLUMINATION OF WAITING ROOM IN THE UNION STATION, WASHINGTON, D. C.

The Union Station at Washington, D. C., which has just been completed, presents some very interesting problems in lighting requirements. In the waiting room of this station, which, by the way, is said to be the largest and most magnificent railroad station in the world, the system of illumination used is unique and in nowise detracts from the imposing appearance of the room. In fact, the beauty of the room and its decorations are enhanced by the illumination, which in quality is very nearly equal to daylight.

In the preliminary design of the main waiting room it was decided to use some system of lighting by which the fixtures and lamps would be concealed. The room covers a floor space of 120 feet wide by 230 feet long, and has a barrel-shaped ceiling of 60 feet radius, the highest point of which is about 98 feet from the floor. A series of five alcoves which form galleries over the entrance vestibules run along the sides of the galleries across the ends of the room. The ceiling is light in color and is decorated with gold leaf. While not elaborate,

Waiting Room in Union Station, Washington, D. C.

the decorations are rich and in complete harmony with the fixtures and architecture.

Banks of inverted direct-current series arc lamps specially constructed by the General Electric Company are placed in the alcoves and back of the balustrade on top of the colonnades, with corrugated mirror reflectors behind them to throw the light to the ceiling, whence it is reflected to the floor. As an aid to the reflectors, magnetic coils, which tend to draw the arc toward the waiting room, are installed on the lamps and give good results. To soften the light and reduce the bluish-white tint characteristic of arc lamps, glass screens of a light yellow tint are placed over the lamps and reflectors.

The lighting equipment consists of a total of 162 lamps, so arranged that several combinations in the number of lamps in service may be obtained. A number of tests were made with all possible combinations of lamps, and from the results of these tests it was found: That this system of indirect lighting gives almost perfect diffusion; that with all lights burning, at reading distance from the floor, about forty-two inches, the illumination is practically uniform, thus making the use of auxiliary seat lights for reading purposes not only unnecessary, but out of harmony in color and arrangement with the general scheme employed. The light is a very close approach to daylight and gives practically true color values.

The accompanying illustration showing one view of the main waiting room was taken at night with all the lamps on, and without the aid of any flashlights or auxiliary lighting. While giving but a faint idea of the real beauty of the room when illuminated, it will be noticed in the illustration that the illumination is uniform, and also that all harsh and unnatural shadows are eliminated.

ALLIS-CHALMERS COMPANY EARNINGS.

The total earnings for the year ended June 30, 1908, after deducting cost of manufacturing and selling, taxes, insurance, and other general expenses, dividends on preferred stock outstanding of the Bullock Electric Manufacturing Company, and ordinary provision for doubtful accounts, were $2,573,950 93

Loss:

Expenditures for maintenance, repairs and renewals on buildings, machinery, plant, tools, etc.	$778,476 64	
Reserves for depreciation on buildings, machinery, plant, tools, etc.	313,778 60	
Interest on bonds and notes payable	805,891 45	
Special reserve	60,000 00	
		1,958,146 69

Net earnings for the year ..... $ 615,814 24

Inasmuch as, owing to present financial conditions, there may possibly be a shrinkage in the collection of certain bills receivable, it has been deemed advisable, out of abundant caution, to set aside out of the profits, on this account, the special reserve of $60,000 shown above.

Beginning with the second quarter and continuing for half of the fiscal year, owing to the severe contraction in general business throughout the country, the volume of the company's sales averaged about one-half of normal. During the last quarter there was a gradual and steady increase in orders booked.

Noteworthy success has been attained in the sale and operation of our new lines of production, namely, gas engines, steam turbines, hydraulic turbines, and electrical apparatus, which are now among the standard products of our company, their development having been completed since the last report. The extended use of these lines of production, often in connection with our older products, not only by purchasers who have long been regular customers, but by numerous new customers in almost all classes of industry, forms the basis for an increasing and profitable business.

During the year advantage was taken of an opportunity to sell the old South Foundry and three vacant lots at the Reliance Works, no longer required for business purposes. Part of the proceeds were used to install a new brass foundry at the West Allis plant, to replace the one vacated on the South Foundry property; the balance to acquire some real estate in West Allis and to purchase in the open market one hundred and thirty-one of our first mortgage bonds, which have been canceled.

ANNOUNCEMENT.

The Harvard Electric Company, 66 West Van Buren Street, Chicago, Ill., and 136 Liberty Street, New York, N. Y., announces that although its Chicago factory and stock were seriously damaged by fire, which occurred August 28th, its new factory at Chicago, equipped throughout with modern and improved machinery, is now in full operation, and that orders for fuse wire, fuse links, telephone fuses, conduit boxes, sectional switch boxes, portable lamp guards, wire connectors, brass cleats, etc., etc., will be filled promptly. The well-known high standard of "Harvard Specialties" will not only be maintained as in the past, but will be heightened by new methods and improved means of manufacture.

APPROVED DEVICES

This Department From Time to Time Will Contain Description of Electrical Fittings Approved by the Underwriters' National Electrical Association

AUTOSTARTERS.

Automatic self-starting compensators for motors from 5 to 50 horsepower, 110 volts, and 5 to 100 horsepower, 220, 440, and 500 volts, 2 and 3 phase. Standard motor panels carrying compensator coils and General Electric contactors automatically controlled. Approved October 1, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

ATTACHMENT PLUGS, FUSED.

"Perkins," 3 amperes, 250 volts. For use with approved glass tube enclosed fuses. Cat. No. 3386. Approved September 21, 1908. Manufactured by

Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

CABINETS.

"E. M. Co." steel panelboard cabinets with steel brim and door. Approved September 11, 1908. Manufactured by

Electrical Mfg. Co., 1363 W. Second St., Cleveland, Ohio.

CONDUIT BOXES.

Brass covers with fibre linings 1/32-inch thick. Cat. Nos. 364 and 365 for mounting receptacles. Approved September 14, 1908. Manufactured by

Bryant Electric Co., Bridgeport, Conn.

CONDUIT BOXES, FLOOR OUTLETS.

T. & B. watertight floor outlet; a cast-iron box with brass plate and cap, Hubbell plug and receptacle, rated 3 amperes, 250 volts. Approved September 1, 1908. Manufactured by

Thomas & Betts Co., 299 Broadway, New York, N. Y.

"Patterson" (formerly "Simplex") floor boxes. Cat. Nos. 3000-AB, 3000-ABP, and 3000-BP; adjustable types, 4000-B and 4000-BP. Approved September 17, 1908. Manufactured by

Stanley & Patterson, 23 Murray St., New York, N. Y.

CONDUIT, MISCELLANEOUS.

Bituminized Fiber Conduit. Approved for use in central stations when laid with its entire length in concrete, June 10, 1908. Manufactured by

American Conduit Co., Marquette Bldg., Chicago, Ill.

CONDUIT OUTLET BUSHINGS AND COUPLINGS.

Type "R, Bendhick," a cast metal outlet and reducing bushing for use in securing ½-inch conduit to metal boxes having ¾-inch holes. Approved August 31, 1908. Manufactured by

Fairmount Electric Mfg. Co., 2320 Market St., Philadelphia, Pa.

CUT-OUT BASES, CARTRIDE FUSE.

All standard patterns, 3-30 and 31-60 amperes, 250 volts. Approved June 17, 1908. Manufactured by

H. T. Paiste Co., 32d and Arch Sts., Philadelphia, Pa.

WIRE, SLOW-BURNING.

Insulation consisting of three braids. Approved June 17, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

FIXTURES.

"White" adjustable straight electric fixtures, ceiling, wall, bench, table, desk, bracket and portable types. Approved September 19, 1908, when wired with approved portable cord, having 1/32-inch rubber insulation on each conductor. Manufactured by

The O. C. White Co., 17 Hermon St., Worcester, Mass.

FUSE PLUGS.

"Weber" Edison plug fuses, 0-30-A., 125 volts. Manufactured by

Weber Electric Co., Schenectady, N. Y.

Bryant Non-Arcing Indicating Plug Fuse, Edison Type. 0-30 A., 250 V. Cat. Nos. 329-340 inclusive. Approved June 10, 1908. Manufactured by

The Bryant Electric Co., Bridgeport, Conn.

GROUND CLAMPS.

"Boston" ground clamp, a device consisting of two timed brass plates with set screws for use on signaling systems only. Approved September 10, 1908. Manufactured by

Cameron Appliance Co., Bartlett Street, Boston, Mass.

"Vogel" clamp for signal systems only. A ½-inch soft copper band, heavily tinned, and brass clamping device. "Bulldog" clamp for rigid conduit. A ½-inch copper strap with clamping screw forming lug for soldered connection to ground wire. Approved June 22, 1908. Manufactured by

Fairmount Electric Mfg. Co., 2322 Market St., Philadelphia, Pa.

MISCELLANEOUS.

General Electric pendant and desk type cigar lighters. Catalogue Nos. 39,523 and 75,234 respectively; 125 volts. Approved September 3, 1908. Manufactured by

General Electric Company, Schenectady, N. Y.

"Oamco" footlight and border light sections for use on theater stages; sheet steel bodies with approved receptacles and wiring and equipped with a suitable guard for borders. Catalogue Nos. 587, 591, 592, 592A, 608, 673, and 674. Approved August 31, 1908, when installed in compliance with Rule 31-A3, or 31-A-4, National Electrical Code. Manufactured by

Overbaigh & Ayres Mfg. Co., 232 S. Clinton St., Chicago. Ill.

Automatic electric shoe polisher. A coin-operated, motor-driven device, having the switches, wiring connections, motor, brush, and dust receptacle mounted on a removable wooden base enclosed in a metal case. Connection to supply circuit made by means of reinforced portable cord and Edison attachment plug. Approved September 14, 1908. Manufactured by

Electric Shoe Polisher Co., Great Northern Bldg., Chicago, Ill.

PANELBOARDS.

"E. M. Co." Two and three-wire panelboards, 125 volts, with or without knife switches in branch circuits, with open link or Nat'l Elec. Code Standard cartridge enclosed fuses. Approved September 12, 1908. Manufactured by

Electrical Mfg. Co., 1363 W. Second St., Cleveland, Ohio.

Two and three wire panels for 125, 125-250 and 250 volts. With cartridge enclosed or open link fuses in branch circuits. Approved June 24, 1908. Manufactured by

Nyelic Switchboard Co., 485 First Ave., New York, N. Y.

RECEPTACLES FOR ATTACHMENT PLUGS.

General Electric flush receptacle and plug, Cat. No. 33,441, 10 amperes, 125 and 250 volts. General Electric flush receptacle, Cat. No. 36,817; for use with Edison type attachment plug; 3 amperes, 250 volts. Approved September 1, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

RECEPTACLES, STANDARD.

"Bryant," 3 amperes, 250 volts, sign, Cat. Nos. 1700, 46,749, and 59,108; cleat, Cat. Nos. 9402, 9403, 921, 1011, 1123, 50,715, 11,221, 28,795, 58,949 (formerly 23,209), 58,306, and 58,301 (formerly 23,210); concealed, Cat. Nos. 50,744, also 9447, fusible, 2 amperes, 135 volts; moulding, Cat. Nos. 42,453, 58,302, and 58,950 (formerly 34,152).

Conduit box, Cat. Nos. 9514, 9397, 40,507, 40,537, and 59,107.

Rosette receptacles, cleat and concealed types, fusible, 2 amperes, 125 volts; Cat. Nos. 9434, 9436, 9438, 9404, 1405, and 9406. Approved September 1, 1908. Manufactured by

Bryant Electric Co., Bridgeport, Conn.

Porcelain shell keyless, 3 amperes, 250 volts, cleat type, Cat. Nos. 28,794, 28,795, 11,221, and 59,275; concealed type, Nos. 50,744, 50,717, and 49,355. Conduit box, Nos. 9397, 40,537, 49,354, and 9514. Sign receptacle, No. 46,627. Wall sockets, brass shell, key, 50 candle-power, keyless, 3 amperes, 250 volts. Concealed base, Nos. 9184, 27,742, 29,404, 9185, 27,743, and 29,405. Angle base, Nos. 50,753, 28,721, with slotted or closed bases and numbers, 29,406, 5075, 28,772, and 29,407. Approved September 1, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

"Weber" wall receptacles, brass shell types, with bases either solid or slotted. Brass shell, key and keyless, 50 candle-power, 250 volts, 3 amperes, 250 volts respectively. Cleat type, Cat. Nos. 61,672 and 61,674. Concealed type, Cat. Nos. 61,673 and 61,675, angle base type, Cat. Nos. 61,676 and 61,677. Cleat type, Cat. No. 61,001; concealed type, Cat. No. 61,000. Approved August 3, 1908. Manufactured by

Weber Electric Co., Schenectady, N. Y.

"Perkins" brass shell wall sockets. Key, 50 candle power, 250 volts; keyless, 3 amperes, 250 volts. Cat. Nos. 9184 and 9185P, slotted or closed base types. Approved September 14, 1908. Manufactured by

Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

RHEOSTATS.

"Inductor-Compensator." An auto transformer for use in the arc lamps circuit of moving picture machine outfits. Primary voltage 90-115 A. C. Approved September 10, 1908. Manufactured by

Don J. Bell, 90 E. Illinois St., Chicago, Ill.

Armature speed controllers. Types KRE, KUE, HRE, HUE, TR, VR, and R, 100-600 volts. Generator field rheostats, types FF, FB, FFE, and FBE, 50-600 volts. Motor field rheostats, types FM, FME, SM, SME, EM, ENIE, 125 and 250 volts. Theater dimmers, types BD, SO, and IBO, 125 and 250 volts. Approved September 15, 1908. Manufactured by

Ward-Leonard Electric Co., Bronxville, N. Y.

Motor starting rheostats, 125, 250, and 500 volts. Types SKE, SUE, ESK, SKN, SUIV, CSK, CSU, SKEB, SUEB, RSU, ERSU, SIK, and SIH. Approved September 19, 1908. Manufactured by

Ward-Leonard Electric Co., Bronxville, N. Y.

ROSETTES, ENCLOSED FUSE.

"Thomas," 3 amperes, 250 volts, cleat, concealed and moulding types for use with approved glass tube, enclosed fuses. Cat. Nos. 3423, 3424, and 3425. Approved September 21, 1908. Manufactured by

Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

ROSETTES LINK FUSE.

General Electric Co. cleat and concealed types. Cat. Nos. 39,234 and 39,236; 2 amperes, 125 volts. Approved September 2, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

SOCKETS, STANDARD.

General Electric brass shell sockets, with or without shade holders. Edison type, key, Cat. Nos. 9386, 1317, 50,760, 44,389, 1318, 99,386, and electrolier, Cat. Nos. 29,623 and 29,624; keyless, Cat. Nos. 9392, 1319, 50,768, 44,390, 1320, and 99,392, and 66,237. S. H. types, key, Cat. Nos. 50,713 and 50,761; keyless, Cat. Nos. 50,714 and 50,769. Approved August 31, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

General Electric porcelain shell socket for temporary decorative work. Cat. 37,695. Approved September 1, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

General Electric "Security Snap" key and keyless Edison styles. Cat. Nos. 44,147 to 44,152 inclusive, 44,814 and 44,815, also electrolier keyless, Cat. No. 59,596. Also above types with shade holders attached. Approved September 1, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

C. H. all-porcelain push button sockets, 6 amperes, 125 volts; 3 amperes, 250 volts. Cat. No. 7400. Approved August 17, 1908. For pendant use only in places where they will not be exposed to much usage. Manufactured by

Cutler-Hammer Mfg. Co., 12th St. and St. Paul Ave., Milwaukee, Wis.

SOCKETS, WEATHERPROOF.

"Bryant," 3 amperes, 250 volts. Pendant styles. Porcelain shell, No. 59,107. Approved September 1, 1908. Manufactured by

Bryant Electric Co., Bridgeport, Conn.

Pendant style for festoon work, Cat. Nos. 418, 420, and 420A to F inclusive; with supporting cleat and hook No. 430. Approved September 21, 1908. Manufactured by

Pass & Seymour, Inc., Solway, N. Y.

SWITCHES, FIXTURES.

"Benjamin" Canopy grouping switch, 5 amperes, 125 volts; 2 amperes, 250 volts. Cat. No. 3329. For controlling circuits to chandelier or cluster. A two-circuit electrolier snap-switch mechanism mounted on a special porcelain base which is attached to a cast metal frame mounted within a fixture canopy and carrying ratchet and cord or chain mechanism for operating the switch. Approved September 21, 1908. Manufactured by

Benjamin Electric Mfg. Co., 42 West Jackson Boulevard, Chicago, Ill.

SWITCHES, KNIFE.

"Barkelew" motor starting switches for use with A. C. motors, 2 or 3-phase up to 5 horsepower. A spring controlled double throw knife equipped with cutouts for Nat'l Elec. Code cartridge or enclosed fuses. Fuses are in circuit only when switch is in running position. Approved September 11, 1908. Manufactured by

Barkelew Electric Mfg. Co., Middletown, Ohio.

SWITCHES, PENDANT SNAP.

"P. & S." pendant switches, 3 amperes, 250 volts; 6 amperes, 125 volts. "Feed Thru" switch. Cat. No. 3010. Approved August 31, 1908. Manufactured by

Pass & Seymour, Inc., Solway, N. Y.

WIRES, RUBBER COVERED.

Tag on coil to read, Nat'l Elec. Code Standard, marking. Two green threads running parallel in braid. Approved August 19, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

Tag on coil to read, Nat'l Elec. Code Standard; marking, two green threads running parallel in braid. Approved August 25, 1908. Manufactured by

Detroit Ins. Wire Co., Wesson Ave. and Albert St., Detroit, Mich.

WIRE, SLOW BURNING.

Insulation consisting of three braids. Approved June 22, 1908. Manufactured by

National Conduit & Cable Co., 41 Park Row, New York, N. Y.

NEWS NOTES

FINANCIAL.

Mesa, Ariz.—The water bonds of the town have been sold to the Mesa City Bank for $50,250.

Mesa, Ariz.—The Common Council has opened bids for the water works bonds, but no award has been made.

San Francisco.—California oil companies listed on the local exchange paid $414,612 in dividends in September.

Pasadena, Cal.—W. W. Ogier and others have organized for the purpose of agitating for another water bond election.

San Francisco.—The Spring Valley Water Company has refused to fix a price for which it would sell its plant to the city of San Francisco.

Watsonville, Cal.—The Watsonville Oil Company has levied an assessment of $5.00 per share on the capital stock of the company, delinquent October 25.

San Francisco.—The Record Oil Company has levied an assessment of 5 cents per share on the capital stock of the company, delinquent October 26.

San Francisco.—The Balboa Oil Company has levied an assessment of 1 cent per share on the capital stock of the company, delinquent October 24.

Monrovia, Cal.—The remaining $10,000 of the $20,000 recently voted have been sold to John H. Adams & Co., of New York, at a premium of 2½ per cent.

Honolulu, T. H.—The Honolulu Gas Company has voted to increase the capital stock of the company by $50,000, the new issue to be used in doubling the capacity of the company's plant.

San Francisco.—Attorney A. L. Taylor and associates have made an offer to sell to the city a source of water supply and waterworks with a capacity of 60,000,000 gallons daily for $29,775,000.

San Luis Obispo, Cal.—The town Trustees have appointed a committee to look into the matter of increasing and bettering the water supply of the city. It is proposed to issue bonds to make the necessary improvements.

Oakland, Cal.—The offer of the Contra Costa Water Company to compromise the suit of Alameda County and the State to collect taxes due for 1904 and 1905, which, with dues and penalties amounts to $104,000, is to be rejected on the advice of the Attorney General.

San Francisco.—The Board of Supervisors has called a special election for November 12 to vote upon the question of whether or not the city shall acquire water rights in the Tuolumne Valley and as to whether or not bonds to the amount of $600,000 shall be issued to cover the cost of acquiring lands and to meet other preliminary expenses.

Oakland, Cal.—The gross earnings of the Oakland Traction Company for August, 1908, show a decrease of $5207, but as the operating expenses decreased in the same month $13,175, there was an increase in the net surplus of $8782. The gross earnings of the company for the eight months ending August 31, 1908, show an increase of $36,863, while there was a decrease in the operating expenses of $42,620, making an increase in the net earnings of $79,483, and in the surplus of $59,256.

Oakland, Cal.—The gross earnings of the San Francisco, Oakland & San Jose Railway Company for the month of August, 1908, show an increase of $5024, and as the operating expenses for the month decreased $3328, there was an increase of $8352 in the net earnings and of $6014 in the surplus. The gross earnings of the company for the eight months ending August 31, 1908, increased $76,508, and the operating expenses increased $21,338, giving an increase in the net earnings of $55,170, and an increase of $49,598 in the surplus.

San Francisco.—The Stock and Bond Exchange has listed $9,329,000 first and refunding mortgage 5 per cent gold bonds of the Edison Electric Company, of Los Angeles. The company has $4,000,000 preferred and $9,000,000 common stock. There are $10,000,000 in bonds authorized of this issue, $477,000 underlying, $750,500 assumed and $800,000 debenture bonds. The bonds are dated Sept. 1st, 1902, and are due Sept. 1st, 1922, optional on any coupon date after Sept. 1st, 1907, at $110 and interest. The bonds are in denomination $1000. The interest is payable on March 1st and Sept. 1st, and a sinking fund of 10 per cent of the net earnings after Sept. 1st, 1907, is provided.

INCORPORATIONS.

San Bernardino, Cal.—The Empire Water Company has been incorporated here, with a capital stock of $50,000, by W. W. Coy, T. B. Ward, and T. W. Van Slyke.

San Francisco.—The San Joaquin Oil Company has been incorporated here with a capital stock of $500,000 by F. H. Lathrop, B. L. Wilson and F. E. Horton.

Fresno, Cal.—The Madera Light & Power Company has been incorporated by A. G. Wishon, J. H. Newlin, and W. E. Durfey. The company has a capital stock of $50,000.

Sacramento, Cal.—The Live Oak & Encinal Light & Power Company has been incorporated here, with a capital stock of $20,000, to engage in business at Live Oak and Encinal.

Fresno, Cal.—The British Consolidated Oil Corporation, Ltd., of England, has filed its articles of incorporation here. The capital stock of the company is 200,000 pounds sterling.

Bakersfield, Cal.—The Eclipse Oil Company has been incorporated here with a capital stock of $50,000 by V. W. Nellis, T. Sullivan, R. L. Atkins, F. M. Graham and E. Denick.

San Francisco.—The Southeastern Oil Company has been incorporated here, with a capital stock of $500,000, by C. G. Wilcox, L. Nathan, T. M. Davidson, C. A. Miclenz, and M. L. Euphrat.

San Francisco.—The Kernal Oil Company has been incorporated here with a capital stock of $200,000 by W. E. Stanford, H. A. Rispin, F. H. Meyer, L. H. Cochran and H. F. Peart.

Prescott, Ariz.—The Central Arizona Electric Company has been incorporated here with a capital stock of $200,000 by J. E. Russell and E. S. Clark. A branch office will be established at Chicago.

Newport Beach, Cal.—The Home Gas & Electric Company has been incorporated here with a capital stock of $50,000 by W. S. Cramp, Horace Slater, R. J. Dunn, C. L. Lancaster and F. M. Burbank.

San Francisco.—The Aerial Telephone & Power Company has been incorporated in San Francisco with a capital stock of $200,000 by L. M. Sherwood, F. J. Golden, C. H. Holzborn, W. L. Harshbarger, W. R. Anderson, A. Kovarik and J. T. Geraty.

Eureka, Cal.—The Northwestern Oil Company has been incorporated here, with a capital stock of $100,000, by H. J. Geering, Milton McWarter, Walter N. Clarke, Fred E. Peaslack, and W. Ernest Dickson. The company will develop the supposed oil fields of southern Humboldt County.

Chico, Cal.—The Chico Water Supply Company has been incorporated here with a capital stock of $100,000 by G. F. Robinson, F. H. Howell, S. K. Troxel, E. T. Williamson and J. H. Jones. It is believed that the new company will succeed to the Chico Water Company. All of the capital stock has been subscribed.

TRANSPORTATION.

San Diego, Cal.—The City Council is advertising for sale an electric street railway franchise.

Los Angeles, Cal.—A company is being organized here to promote the making of concrete railroad ties.

Santa Barbara, Cal.—The Edison Electric Company has applied for an electric railway franchise on Bath Street and Fourth Avenue.

San Diego, Cal.—The City Council of this place has advertised for sale the street railway franchise applied for by the Point Loma Railroad Company.

Pasadena, Cal.—The City Council has granted to the Pacific Electric Company a twenty-year franchise for an electric railway on California Street.

Ventura, Cal.—The Ventura & Los Angeles Terminal Railway Company has secured a franchise for an electric railway system in this place.

Los Angeles, Cal.—The Board of Public Works will receive bids till October 19th for trolley material and other supplies for use in the work of building the Owens River aqueduct.

Lodi, Cal.—The Lodi Chamber of Commerce has appointed a committee to co-operate with the Central California Traction Company in securing its right of way for the proposed extension to Sacramento.

Los Angeles, Cal.—The City Council has sold to M. J. Nolan, representing the Los Angeles Railway Company, a franchise on West Washington Street for $250.

Glendale, Cal.—The committee having in charge the promoting of the east side electric railway has secured the entire right of way and will deposit the required bonus of $2,500 in the Bank of Glendale.

San Francisco.—The first step in the removal of the offices of the United Railroads was made a few days ago when the offices of Tirey L. Ford, chief counsel of the company, were established in the Balboa Building on Market Street.

Ontario, Cal.—The Ontario and San Antonio Heights Railway Company is running a survey from the present terminus of its line at San Antonio Park to Stoddard's canyon, and the work of building the new line will commence at once.

Alameda, Cal.—The City Council has finally passed the franchise granting the Southern Pacific Company the right to convert its steam roads in this city to electric roads and to operate a new line encircling the east shore of the city.

Goldfield, Nev.—The County Commissioners of Esmeralda County have granted to George Wingfield and others of this place an electric railway franchise covering the county roads from Goldfield to Jumbotown, Diamondfield and Columbia.

Oakland, Cal.—The Seventh Street Improvement Club has decided to ask the City Council to grant an electric railway franchise on Seventh Street to representatives of the club. The purpose is to hasten the conversion of the Southern Pacific steam line on Seventh Street to an electric line.

Santa Ana, Cal.—The Southern California Sugar Company has assigned to the Pacific Electric Railway Company a right of way recently secured by the sugar company from Talber to Huntington Beach, with the understanding that the railway company shall extend its Huntington Beach electric line to Santa Ana.

Berkeley, Cal.—The Town Trustees have granted to the San Francisco, Oakland & San Jose Railroad Company an electric railroad franchise along Sacramento and Hopkins Streets, for forty-eight years. The line will be operated as a part of the Key Route ferry system, work to commence within one year and the line to be in operation within three years.

San Francisco.—The Board of Supervisors has finally passed the much-discussed ordinance for the regulation of street railroads in spite of the opposition of the officials of the United Railroads and of the Union Street company. It is understood that the companies will carry the matter into the courts. The finance committee of the board has agreed to recommend a compromise in the matter of the percentage to be paid by the United Railroads for the years 1906 and 1907. The amount claimed by the company as due for the two years was $59,491, and by the city, $65,036. The amount fixed by the compromise was $60,710.

WATERWORKS.

Santa Barbara, Cal.—The City Council is asking for bids for the laying of a steel pipe.

Lindsay, Cal.—The managers of the packing houses here are arranging to put in a waterworks plant for fire protection purposes. Ten packing houses will be included.

Sausalito, Cal.—Sealed bids will be received by the City Council till November 16th for supplying the municipality with water for the city distributing system.

Los Angeles, Cal.—The San Gabriel Water Company has been awarded a water franchise in the Lamanda Park section of the city on its bid of $100.

San Diego, Cal.—The Board of Public Works has instructed the superintendent of the water department to install pipe lines on Spruce Street and on Lincoln Avenue, La Jolla.

Imperial, Cal.—The Imperial Light, Water & Power Company is extending its system into several parts of the city not heretofore served.

Santa Barbara, Cal.—The City Water Commissioners have awarded a contract for laying 18,000 feet of pipe through the streets.

Riverside, Cal.—The Lake Hemet Water Company, which supplies the Hemet tract with water, will put down fifteen additional wells and will also commence important water development about the Hemet dam.

Los Angeles, Cal.—The management of the Cudahy Ranch will at once ask for bids for the installation of a complete waterworks system. The estimated cost of the work is $15,000. Pipe ranging from sixteen inches downward will be required.

Los Angeles, Cal.—The Board of Public Works will receive bids till October 16th for B. I. pipe and O. D. casing for use in the construction of the Owens River aqueduct, and till November 2nd for 2740 tons of Standard Bell and Spigot cast iron water pipe.

Yuba City, Cal.—C. B. Andros has asked the Town Trustees $8,000 for the present water-works system, while the Trustees think that $2,500 is an adequate price, and it is now thought that the municipal plant will be established independent of the existing plant.

Pasadena, Cal.—Since the failure of the water bonds election to carry, the residents of South Pasadena have commenced an agitation to have the amount of water to which they are entitled from the Pasadena Land & Water Company settled by the Courts, with a view to establishing a municipal plant for South Pasadena.

OIL.

Los Angeles, Cal.—Patrick Holohan, superintendent of the Virgin River Oil & Development Company, has returned to that section to begin sinking a third well.

San Francisco.—Beginning October 1st the Santa Fe and the Tonopah & Tidewater reduced the freight charge on fuel oil from Bakersfield to Goldfield from $10 to $9.

Bakersfield, Cal.—Eugene Kay, for some time in the employ of the Oregon Oil Company at Midway, has entered the employ of the Producers' Water Company at Midway.

Santa Barbara, Cal.—The sale of 1120 acres of the Rice Ranch in the Santa Maria Oil belt has been sold to the Palmer Oil Company for $500,000. This gives the Palmer Company 1920 acres.

Oakland, Cal.—The Standard Oil Company has filed leases on several thousand acres of oil bearing lands in this county near the Contra Costa County line. The leases run for ten years.

TRANSMISSION.

San Andreas, Cal.—S. L. Davidson has appropriated 20,000 inches of water in the Mokelumne River for power purposes.

Los Angeles, Cal.—The Board of Public Works will receive bids till October 26th for transformers, wire and other electrical supplies.

Yreka, Cal.—The owners of the Klondyke mine are arranging to develop 150 horse-power of electric energy on Ash Creek. The work will be in charge of J. W. Downing.

Napa, Cal.—On November 11, the Board of Supervisors will open bids for a franchise for a farmers' power line from Napa to the Napa-Lake County line. E. D. N. Lehe is the man who asked to have the franchise advertised.

Yreka, Cal.—L. E. Hicks has appropriated water as follows for electric power purposes: 4000 inches from Canyon Creek, 2500 inches from Kelsey Creek, 1500 inches from Middle Creek and 2000 inches from Thompkins Creek.

San Bernardino, Cal.—The Board of Supervisors of San Bernardino County have granted a franchise to the Home Gas & Electric Company, of Redlands, to use certain roads in the vicinity of Redlands for the transmission of electricity.

Modesto, Cal.—The La Grange Water & Power Company, which was recently granted a franchise for an electric transmission system in the eastern part of Stanislaus County has now secured a franchise for an electric lighting and power system in Turlock.

Salt Lake, Utah.—It is reported that Jesse Knight, who controls the new Tintic smelter at Silver City, will erect a power plant with sufficient capacity to operate a plant with more than double the capacity of the present smelter. The smelter has been obliged to close down owing to the fact that the recent storms interfered with the electric current which has heretofore been supplied to it.

San Francisco.—A report from Los Angeles states that a meeting of representatives of power companies was held at the Hotel Alexandra a few days ago to inaugurate a movement to have Congress pass laws enabling power companies to secure perpetual or long term concessions for power transmission lines through government forest reserves rather than the present revokable permits.

Reno, Nev.—F. O. Broili, engineer of the Truckee River General Electric Company, and Walter E. Trent, engineer of the Nevada Machinery and Supply Company, have completed the survey for a power line to connect the main line of the Truckee River General Electric Company with Rawhide. This line will be put in in a few months, and in the mean time Messrs. Broili and Trent will put in an electric plant to be operated by gasoline engines.

ILLUMINATION.

Pomona, Cal.—The Edison Company is preparing to enlarge and extend its gas system at this place.

Albuquerque, N. M.—The constructing quartermaster at Fort Bayard, N. M., is advertising for bids for the installation of electric light fixtures in the administration building at Fort Bayard.

Sausalito, Cal.—Proposals will be received by the Board of Trustees till November 16th for supplying the town of Sausalito with water.

San Francisco.—A new San Francisco Combination Directory is to be issued November 1st, 1908, by the Pacific Telephone & Telegraph Company.

Oakland, Cal.—The Oakland Gas Light & Heat Company has now completed its large 2,000,000 cubic-foot gas holder at the foot of Grove Street.

Quincy, Cal.—The Indian Valley Electric Light & Power Company has applied for a franchise in this place, promising to begin operations on or before May 1, 1909.

Coronado, Cal.—The City Trustees have awarded to John D. Spreckels a contract for the installation of street lights.

Pasadena, Cal.—As the only bidder, the Pacific Electric Railway Company has secured from the City Council a franchise for its line on East California Street to Tournament Park.

Palo Alto, Cal.—The trustees of Stanford University have decided to lay a gas main to connect with the Palo Alto Gas Company's main for the purpose of securing a gas supply for the university.

Yuma, Ariz.—H. W. Blasdell, of the Yuma Electric Light & Water Company, has now secured possession of the Yuma Gas Company's plant and will operate all of the properties under one management.

Bakersfield, Cal.—The Mount Diablo Oil Company has filed suit to prevent Dr. A. P. Shafer from continuing in charge of the company's property and to prevent his interfering with the management named by the company.

Salt Lake City, Utah.—The Board of Public Works has awarded a contract for a gas-producing plant to Fairbanks, Morse & Co., for $6,485, the plant to be ready for operation by December 31. The same company has the contract for installing the required pumps. The contract for a pumping station will be let shortly.

TELEPHONE AND TELEGRAPH.

Petaluma, Cal.—W. D. Thomas has secured the contract for the construction of the new Two Rock telephone line.

Modesto, Cal.—The Board of Supervisors has granted the Sylvan Telephone Company permission to erect poles and string wires along the county roads.

Watsonville, Cal.—It is announced that the Pacific Telephone & Telegraph Company is to make extensive improvements in its system in this city.

Los Angeles, Cal.—The Pacific Telephone & Telegraph Company has bought from the Home Telephone Company of Los Angeles five miles of line, extending from Seventh and Junipero Streets to the Fred Bisby ranch for $2500.

Oakland, Cal.—The Board of Supervisors of Alameda County has refused to accept the offer of the Home Telephone Company of $2500 and two per cent of the gross earnings in payment for a franchise permitting the company to extend its system into the country districts.

Red Bluff, Cal.—The following have identified themselves with the movement to build a farmers' telephone westward from this place: L. M. Bayles, J. L. Burt, Vine & Fredenall, W. R. Harrison, Charles White, John Bohn, Z. J. King, Ralph Henderson, A. A. Martin, and D. Bayles.

POWER AND LIGHT.

Guadalajara, Mexico.—The Atonilco Light & Power Company, recently organized by Guadalajara men to furnish light and power to the town of Atonilco, the center of the orange district of Jalisco, has placed an order with the Siemens-Schuerwerke Company, of Berlin, Germany, for hydro-electric machinery, transmission lines, and sub-station equipment.